CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 03 - in effect as of: 28 July 2006

CONTENTS

Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

>>

Organic Waste Composting at Takon Palm Oil Mill, Malaysia
Version 2. 30/06/2008.

A.2. Description of the project activity:

>>

The project comprises the design of a co-composting plant for waste from Takon Palm Oil Mill, comprising the Empty Fruit Bunches (EFB) and the Palm Oil Mill Effluent (POME) from the mill residue, with an annual input capacity of 47,520 tonnes/annum fresh EFB and 129,600 m^3/year POME, according to MPOB studies [2]. Apart from compost fertilizer, the project will realise methane reductions by diverting POME from the anaerobic ponds at the mill and high organic waste from dumping at landfills (where anaerobic process occurs) to a composting plant (aerobic process). Most landfills in Malaysia are poorly controlled sites with no coverage or landfill gas extraction.

Based on investigations and calculations the project will realise 587,337 tonnes CO_2 equivalents over the 10-years period 2008 – 2018. The investments will be realised during the period 2007 till 2008. Delivery of CERs will start from 2009 as this project is expected to be registered in 2008.

The EFB has high moisture content, making it heavy and unsuitable for incineration or long-distance transport, and it also contains substantial amount of degradable organic carbon (DOC). The moisture content and carbon-nitrogen ratio of 35-50 is optimum for aerobic composting[3]. As such, composting of this waste is an attractive option for resource recovery and environmental improvement. The EFB are produced in abundance in the area, were generally incinerated or open burned, but are now piled to decompose since open burning has been prohibited as a disposal option. Uncontrolled land filling is prevented by the Project activity and highly demanded compost is generated that combats soil degradation that is a severe problem in palm oil plantations. The project therefore contributes to sustainable development of the agricultural sector in the region.

The plant will be mechanised, but will still create a number of jobs (min. 10-15 jobs), in particular for less educated workers. In addition, the introduction and transfer of co-composting technology to the local community will allow them to acquire new technique which will increase their living environment and standard.

Composting might cause some local environmental impact, mainly odour emission, but the choice of in-vessel composting minimizes any possible odour problems. The composting plant is located near the existing milling operations. An organic deodourizer may be applied, which will not only eliminate any odour emission, but also supplement the compost with additional organic and nutrient contents, and therefore, can contribute to the compost generation.

---

2 Industrial Process & the Environment Handbook No. 3 – Crude Palm Oil Industry, Malaysian Department of Environment

3 Compost Fundamentals – Washington State University
http://whatcom.wsu.edu/ag/compost/fundamentals/needs_carbon_nitrogen.htm

A.3. Project participants:

>>

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Malaysia (host)	Sankina Oil Mills Sdn. Bhd. (private company)	No
United Kingdom of Great Britain & Northern Ireland	Aretae Limited (private company)	No
(*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required.		

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

>>

A.4.1.1. Host Party(ies):

>>

Malaysia

A.4.1.2. Region/State/Province etc.:

>>

Sabah

A.4.1.3. City/Town/Community etc:

>>

Lahad Datu

A.4.1.4. Detail of physical location, including information allowing the unique identification of this project activity (maximum one page):

>>

Detail of physical location:
7.7km Off the 65th KM Lahad Datu-Tungku Road, Mukim Ulu Tungku, Lahad Datu, Sabah, Malaysia

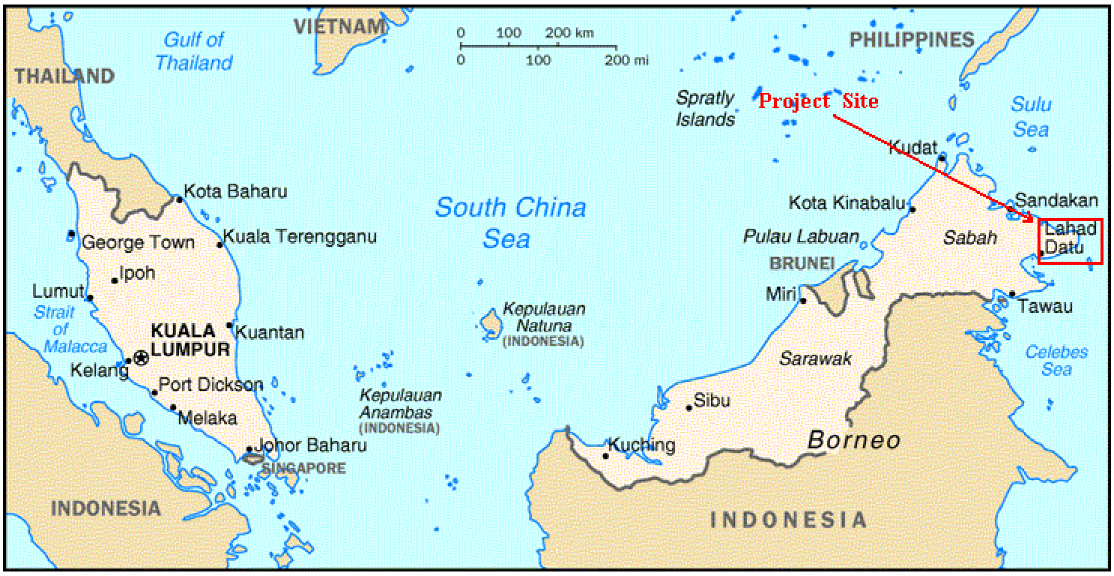


Figure 1. The Location of the Project Site

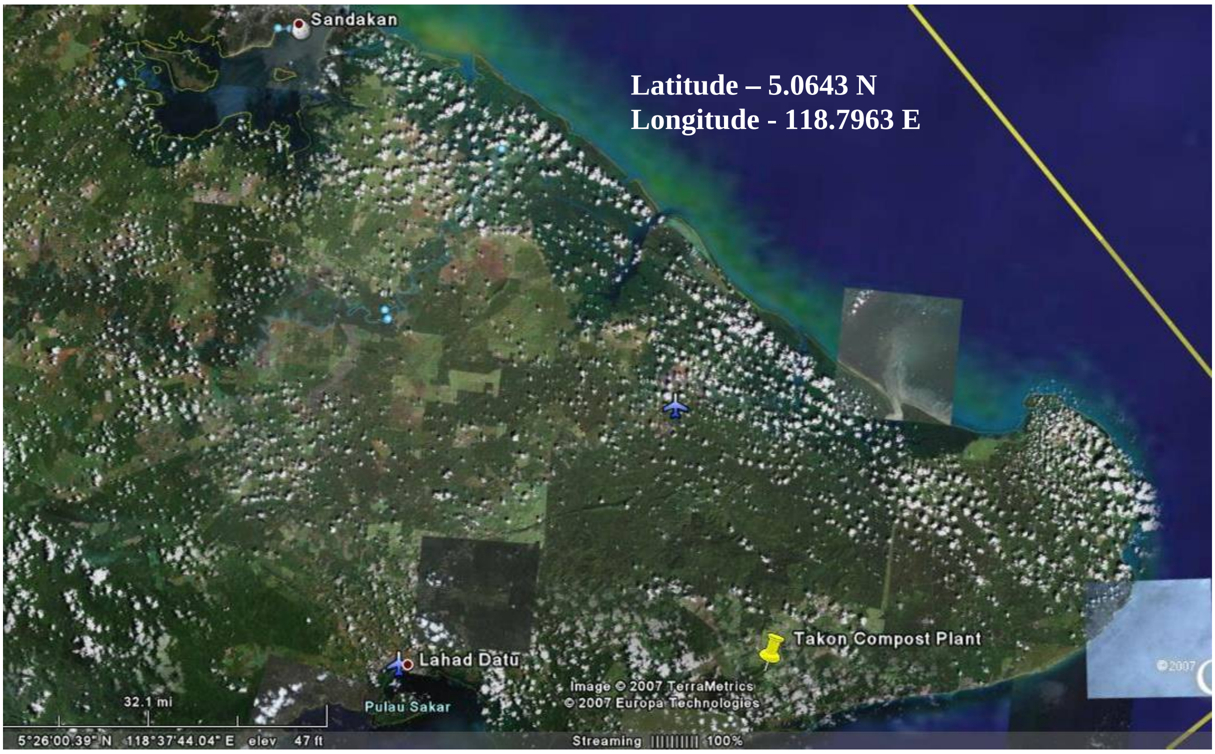


Figure 2. The Location of the Project Site

A.4.2. Category(ies) of project activity:

>>

Project Activity: Sector 13-Waste handling and disposal

A.4.3. Technology to be employed by the project activity:

>>

The technology proposed for the composting plan is proven technology but relatively new to Malaysia. A number of similar plants exist in Philippines and China, but none using combined EFB and POME waste. International standards and good labour conditions will be taken into account, with the processing equipment technology sourced from Germany and the microbe technology coming from Canada. Technological or technical constraints are not expected. The composting plant is designed for a processing capacity of 160 tonnes of organic waste input per day (2008)[4].

The project activity will involve the construction and operation of a composting plant near the palm oil mill. The system includes the construction of roof covered channels that are sufficiently long, wide and deep for the finely shredded EFB to be placed form composting. The compost in the channel shall be turned daily to ensure that process remains aerobic throughout the entire composting period. The concrete walls shall have a system of aeration with blowers to provide additional aeration for the lowest layer of the compost. The “Air Wall” shall also be designed to serve as a practical leachate collection system so that POME sprayed onto the compost that is in excess can be re-circulated.

The project includes primary shredders, gantry movers, compost turners, transfer conveyors, full aeration system for the channel, blowers, blower control, SCADA monitoring system and all other plant and equipment required to process the EFB to an organic fertilizer. 50% of the raw POME from the palm oil mill will be pre-treated to remove suspended solids. The pre-treated POME will be mixed with the EFB in the composting channels. A holding-tank will be included to store any excess POME for recirculation to the composting channels. Nitrogen-fixing microbes may be added to enhance the performance of the fertilizer

Any POME after the suspended solid separation step that is not used will be directed to the existing aeration ponds, where the DOC at the end of the process will be measured, as well as the volume of effluent from these ponds. Any leachate POME will be collected and directed back to the channels for composting.

Process step

An overall scheme of the process is presented in Figure 3 on the next page.

---

[4] One tonne of net input will result in approximately 500 kg of compost. The planned total gross input of 156 tonnes per day (47,520 tonnes per year) results in approximately 78 tonnes of compost per day (23,760 tonnes per year), based on half the EFB quantity. These figures are continuously monitored (see monitoring plan).

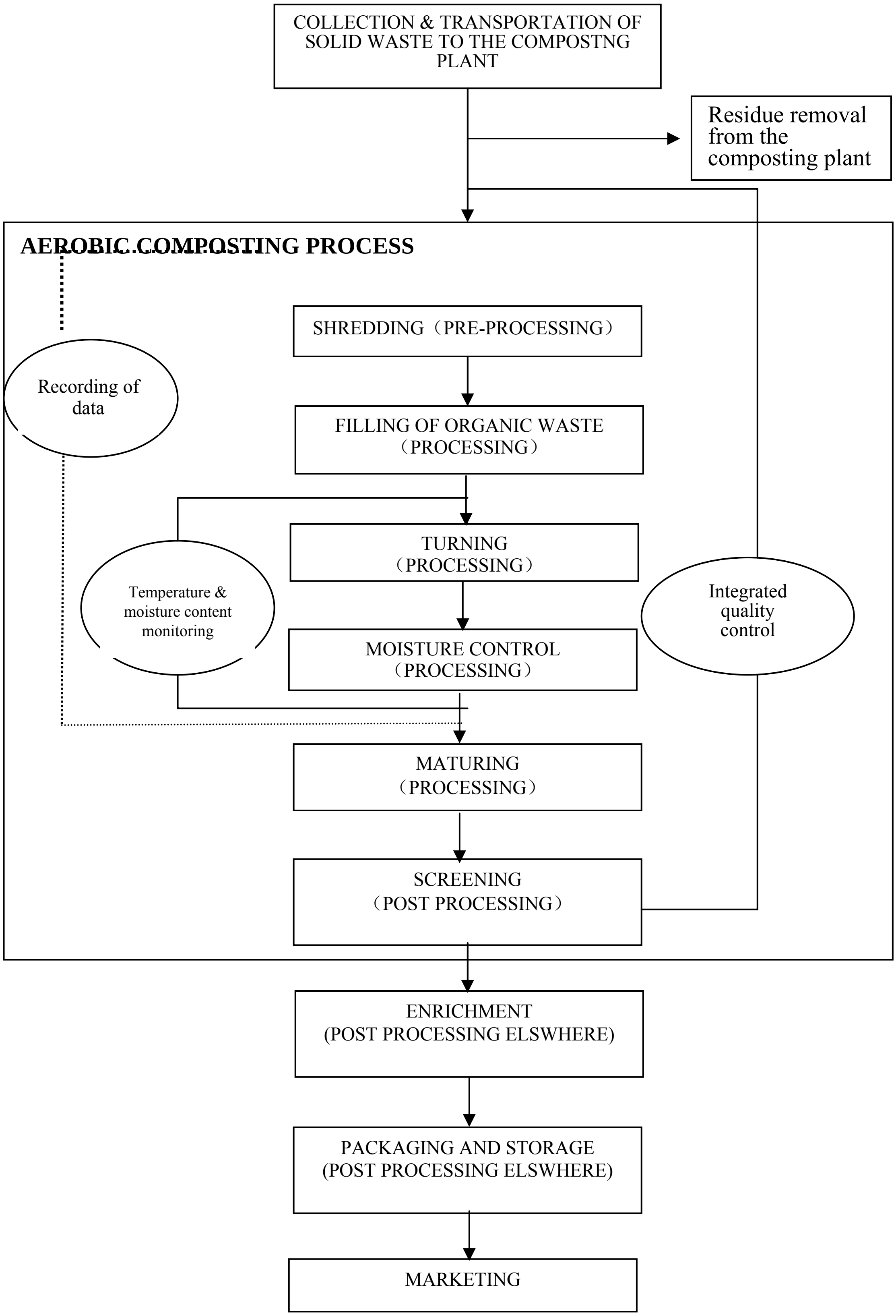


Figure 3. Different steps in the composting process

A.4.4 Estimated amount of emission reductions over the chosen crediting period:

>>

.

Table - Estimated emission reductions from the project

Year	Annual estimation of emission reductions in tonnes of CO_2e
2008 (2 months)	2,474
2009	22,772
2010	34,616
2011	44,609
2012	53,040
2013	60,153
2014	66,154
2015	71,216
2016	75,488
2017	79,091
2018 (10 months)	77,724
Total estimated reductions (tonnes of CO_2e)	587,337
Total number of crediting years	10
Annual average over the crediting period of Estimated reductions (tonnes of CO_2e)	58,734

A.4.5. Public funding of the project activity:

>>

There is no public funding in this project.

SECTION B. Application of a baseline and monitoring methodology

B.1. Title and reference of the approved baseline and monitoring methodology applied to the project activity:

>>

Baseline Methodology: The approved AM0039, version 1 “Methane emissions reduction from organic waste water and bioorganic solid waste using co-composting”

Monitoring Methodology is from AM0039, version 1.

B.2 Justification of the choice of the methodology and why it is applicable to the project activity:

>>

The methodology is applicable to project activities that avoid methane emissions:

- Resulting from anaerobic degradation of the organic wastewater in open lagoons or storage tanks; and
- From natural decay of bioorganic solid waste in landfills

The methodology is applicable under the following conditions:

- Organic wastewater and bioorganic solid waste can be generated at separate locations;
- The bioorganic solid waste can be of a single type or multiple types mixed in different proportions. The proportions and characteristics of different types of bioorganic waste processed in the project activity can be determined, in order to apply a multiphase landfill gas generation model to estimate the quantity of landfill gas that would have been generated in the absence of the project activity;
- Project activities shall employ co-composting process for treatment of the organic wastewater and the bioorganic waste;
- The anaerobic lagoons or storage tanks utilized for the treatment of the organic wastewater, which is processed in the project co-composting activity, in the baseline shall meet the following conditions:
  - The monthly average ambient temperatures are greater than 10°C;(the methodology is applicable even if some of the months during the year have average ambient temperature less than 10°C, but in such cases only months where monthly average ambient temperatures are greater than 10°C shall be included in estimation of methane emissions)
  - Depth of the wastewater anaerobic lagoon or storage tank is greater than 1m;
  - Residence time of the organic matter should be at least 30 days.

NOTE: The methodology is only applicable if the baseline is:

- Landfilling of the bioorganic waste; and
- An existing or new to be built anaerobic lagoons or open tanks for the treatment of organic wastewater.

For Baseline Methodology: The approved AM0039, version 1 “Methane emissions reduction from organic waste water and bioorganic solid waste using co-composting” is used, because there is no viable alternative for the EFB to be used except for disposal in a landfill, which is the current practise.

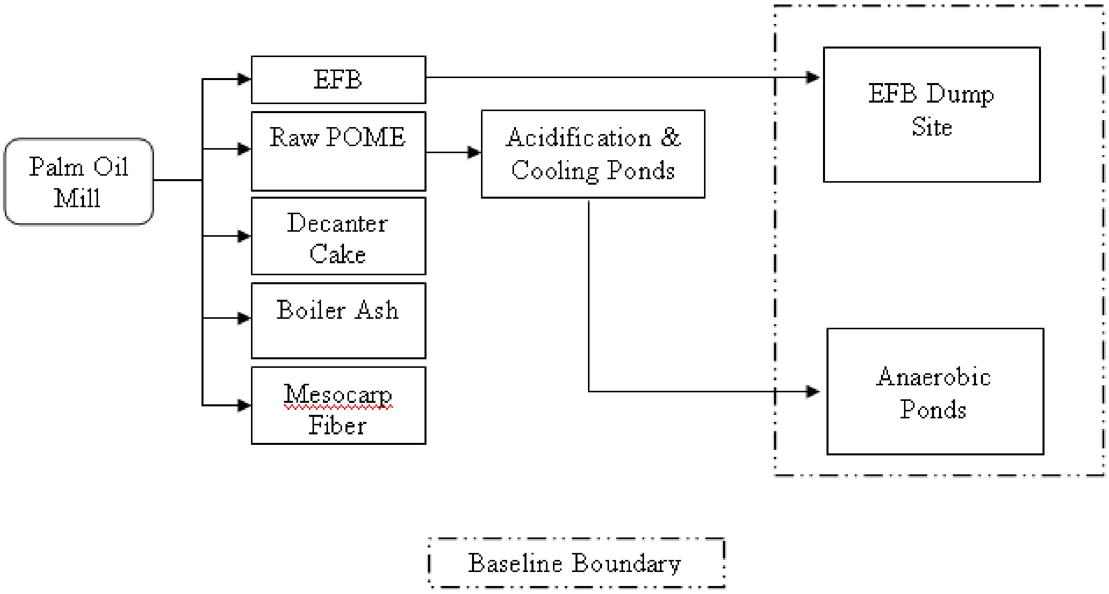
The POME wastewater is currently anaerobically treated in ponds that give a residence time of more than 60 days, and then polished in aerobic ponds in order to meet water effluent standards for surface water disposal.

B.3. Description of the sources and gases included in the project boundary

>>

The project boundary is the composting site where waste is treated. Possible CO_2 emissions resulting from fuel combustion and electricity consumption in the operation of the project activity will be accounted as project emissions. Methane emissions are avoided by the aerobic composting activity. Some methane may be produced from anaerobic pockets in the compost. N_2O emissions will be produced during the composting process.

The flow chart in Figure 4 shows the main components and connections including system boundaries of the project. The Table following details the source of greenhouse gas emissions from the various gaseous emissions and emission reductions from the Project activity.



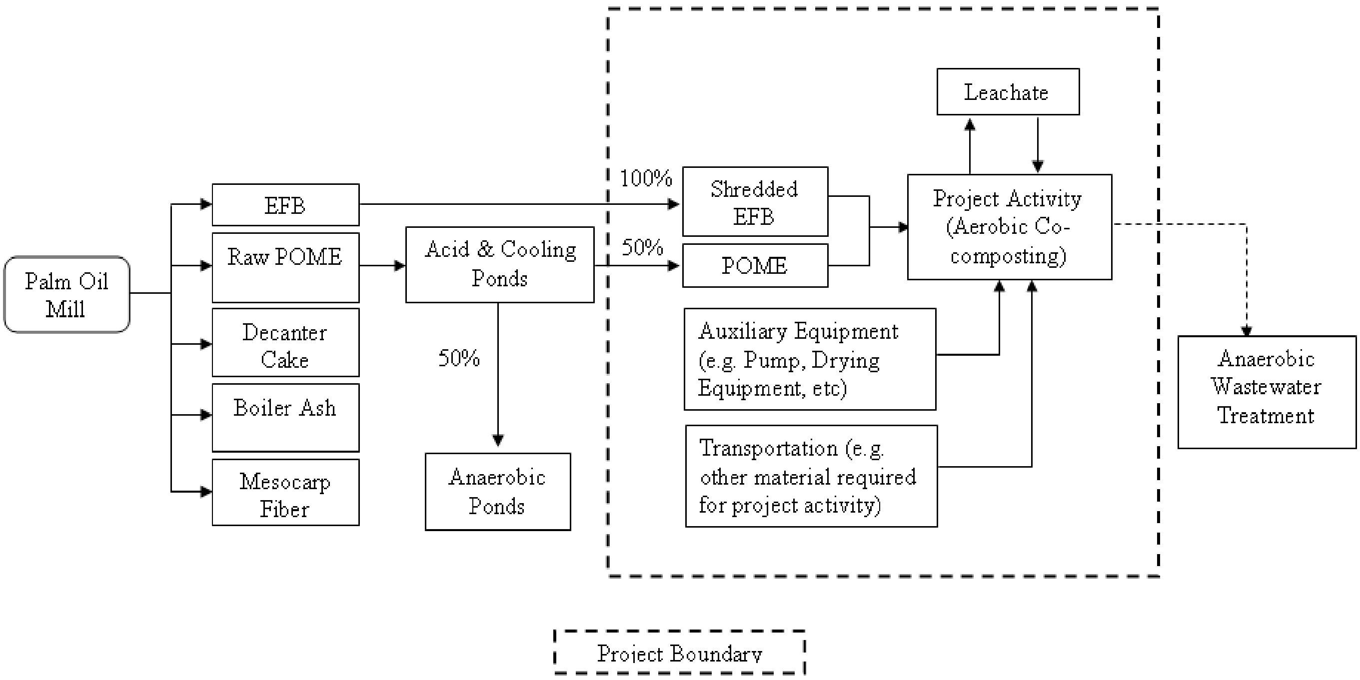


Figure 4. Project Boundary

Emissions sources included in or excluded from the project boundary are shown in Table 1.

Table 1: Summary of gases and sources included in the project boundary,

	Source	Gas	Included?	Justification / Explanation
Baseline	Biomass disposed in unmanaged landfills	CO_2	No	CO_2 emissions from biomass decay in landfills are considered GHG neutral.
		CH_4	Yes	Methane emission from biomass decay in the landfills
		N_2O	No	Not significant. Excluded for simplification and conservativeness.
	Open Lagoons	CO_2	No	CO_2 emissions from biomass source are considered GHG neutral.
		CH_4	Yes	Methane emission from anaerobic process.
		N_2O	No	Not significant. Excluded for simplification and conservativeness.
	Transportation	CO_2	No	Emission from combustion of fossil fuel in transport vehicles.
		CH_4	No	Not significant. Excluded for simplification and conservativeness.
		N_2O	No	Not significant. Excluded for simplification and conservativeness.
	Auxiliary Equipment	CO_2	No	Emission from Grid Electricity or Fossil fuel.
		CH_4	No	Not significant. Excluded for simplification and conservativeness.
		N_2O	No	Not significant. Excluded for simplification and conservativeness.
Project Activity	Composting process	CO_2	No	CO_2 emissions from composting process are considered GHG neutral.
		CH_4	Yes	Methane emissions from anaerobic pockets during composting process.
		N_2O	Yes	N_2O emissions from loss of N_2O-N during composting process and during application of the compost.
	Leaked Waste Water	CO_2	No	CO_2 emission from biomass source and considered GHG neutral.
		CH_4	Yes	Methane emission from anaerobic process of wastewater collected after the project activity.
		N_2O	No	Not significant, excluded for simplification.
	Additional Transportation due to Project Activity	CO_2	Yes	Emission from combustion of fossil fuel in transport vehicles.
		CH_4	No	Not significant, excluded for simplification.
		N_2O	No	Not significant, excluded for simplification.
	Auxiliary Equipment	CO_2	Yes	Emission from Grid Electricity or Fossil fuel.
		CH_4	No	Not significant, excluded for simplification.
		N_2O	No	Not significant, excluded for simplification.

B.4. Description of how the baseline scenario is identified and description of the identified baseline scenario:

Step 1: Draw up a list of possible realistic and credible alternatives for the treatment of the organic wastewater and bioorganic solid waste.

Alternatives to be analysed should include, ***inter alia***:

For organic wastewater:

- Alternative 1: Continuation of current practice of using anaerobic lagoons or open storage tanks without methane recovery and flaring;
- Alternative 2: Anaerobic lagoons or storage tanks with methane recovery and flaring;
- Alternative 3: Anaerobic lagoons or storage tanks with methane recovery and utilization for electricity or heat generation;
- Alternative 4: Building of a new anaerobic lagoon or open storage tanks without methane recovery and flaring;
- Alternative 5: Building of a new anaerobic lagoon or open storage tanks with methane recovery and flaring;
- Alternative 6: Using the organic wastewater for co-composting (The project activity implemented without CDM)
- Alternative 7: Other treatment options provided in table 6.3, Volume 5, chapter 6 of the IPCC 2006 guidelines for greenhouse gas inventory.

For bioorganic solid waste:

- Alternative A: Waste used for co-composting (the project activity implemented without CDM);
- Alternative B: Uncontrolled open burning;
- Alternative C: Waste returned to the plantation for mulching;
- Alternative D: Waste incinerated in controlled conditions or used for energy purposes including power generation;
- Alternative E: Waste disposed on a landfill without the capture of landfill gas;

- Alternative F: Waste disposed on a landfill where landfill gas is captured and flared;

- Alternative G: Waste disposed on a landfill where landfill gas is captured and electricity generated;

- Alternative H: Waste disposed on a landfill where landfill gas is captured and delivered to nearby industries for heat generation.

Step 2: Eliminate alternatives that are not complying with applicable laws and regulations

For organic wastewater:
All the alternatives mentioned in **Step 1** comply with applicable laws and regulations.

For bioorganic solid waste:
All the alternatives mentioned in **Step 1** except Alternative B (uncontrolled open burning) comply with applicable laws and regulations since Malaysia has banned open burning in plantation. Therefore, Alternative B will not be included in further assessment.

Step 3: Eliminate alternatives that face prohibitive barriers

Investment Barriers

- **Alternative 1:**
  This is the current practice at the mill and would be continued if no Project were considered to provide a comprehensive solution to manage the overall waste problem at the Palm Oil Mill. This current practice does not face any investment barriers as this represent the continuation of the common practice at the host country.

- **Alternative 2:**
  There is no legal requirement to recover and destroy methane from the process. Also, this alternative will require high investment for new methane recovery system, lagoons, storage tanks and flaring equipments etc. For example, TSH Bio-Gas Sdn Bhd had invested RM 16.5 million for their biogas recovery project at 50TPH mill. In addition, in this remote there is no market for electricity or heat generated by the capturing of biogas from these lagoons given that the mill has sufficient energy supply from burning mesocarp fiber and palm kernel shells. Therefore, it would not be an attractive option without any additional revenues. This alternative is ruled out.

- **Alternative 3:**
  Methane recovery from the anaerobic lagoons is possible. However, since the mill has sufficient mesocarp fibers and shells for all the energy and power needed for the mill, they will not prefer to recover methane due to high investment (as stated in Alternative 2) and additional material handlimg. This alternative is ruled out.

- **Alternative 4:**

The lagoons at the mill are quite new, so this is not a realistic option, and in any case would be the same as the baseline scenario. Moreover, additional investment is required without additional revenues being generated. This alternative is ruled out.

- **Alternative 5:**
  The ponds are new, and do not need to be replaced. Moreover, additional investment is required without additional revenues being generated. This alternative is ruled out.

- **Alternative 6:**
  This option will be analyzed as part of the Additionality evaluation as outlined in section B.5 below. The evaluation suggests that this option is not considered viable as it would face investment barrier.

- **Alternative 7:**
  As listed in Table 6.3, Volume 5, Chapter 6 of the IPCC2006 Guidelines for Greenhouse Gas Inventory, other options include (a) direct discharge of untreated wastewater which is not permitted by Malaysia's regulation; and (b) aerobic treatment facility. Aerobic waste water treatments systems are suitable for relatively low BOD/COD wastes but not for the high BOD/COD wastes generated by the palm oil industry. They are used for polishing treatment after anaerobic treatment to reduce the BOD/COD to a level that is acceptable for discharge to surface waters. A fully aerobic waste water treatment process for raw POME is not technically feasible, nor would it be economically feasible at the moment.

For bioorganic solid waste:

- **Alternative A:**
  This option will be analyzed as part of the Additionality evaluation as outlined in section B.5 below. The evaluation suggests that this option is not considered viable as it would face investment barrier.

- **Alternative C:**
  The mill is part of a plantation complex, and as much of the EFB and mesocarp fiber is returned for mulching as is practical. However, the plantation has a problem with insects and vermin using the piles of mulched wastes to nest and multiply, causing problems with tree growth and vermin control. In addition, the EFB in particular is heavy and the labor to cut and move it into place in the plantation makes this practice untenable. Furthermore, it is not financially attractive due to transport/distribution cost. This causes the large amounts of EFB to be piled into landfills in the mill vicinity. Other nearby palm oil mills have the same problem with EFB disposal. Therefore, this alternative is ruled out.

- **Alternative D:**
  Waste incineration is not a practical option due to the difficulty in obtaining an environmental permit (as Malaysia has banned incineration) and the capital cost for this waste treatment option, with no benefit to cover the cost of the incinerator and flue gas treatment expenses. In addition, EFB with a high moisture and low calorific heating value, requires additional pretreatment costs before is can be used as an effective fuel source for steam and power generation. This alternative is ruled out.

- **Alternative E:**
  This is the current practice for the EFB waste. Continuation of this current practice would require no investments on the part of the project developer, and would not face any technological or other barriers. However, methane gas would continuously be emitted from the solid waste disposal sites.

- **Alternative F:**
  There is no gas capture system on the current piles and the local landfills are small and have no landfill gas recovery systems. Practice of the alternative faces investment barrier of putting in additional investment without generating any additional revenues. Therefore, this alternative is ruled out.

- **Alternative G:**
  There are no landfills of this type in the region. Therefore, this alternative can be ruled out.

- **Alternative H:**
  There are no landfills of this type in the region. Therefore, this alternative can be ruled out.

Technological Barriers

For organic wastewater:

- **Alternative 1:**
  This current practice does not face any technological barriers as this represent the continuation of the common practice at the palm oil mills in the host country.

- All other alternatives have been ruled out due to investment barriers and have been ruled out, except Alternative 6, which will be assessed in section B.5 below.

For bioorganic solid waste:

- Most alternatives mentioned in Step 1 above face investment technological barriers and have been ruled out, except Alternative A and Alternative E, which will be discussed in section B.5 below.

Step 4: Compare economic attractiveness of remaining alternatives

Compare the economic attractiveness without revenues from CERs for the remaining Alternative 1 (for organic waste water) and Alternative E (for bioorganic solid waste) by applying Step 2 of the latest version of the “Tool for demonstration and assessment of additionality” agreed by the CDM Executive Board.

There are two remaining alternatives: First, continuation of current practice (Alternative 1 and Alternative E) and second, the project activity implemented with CDM financing.

Continuation of the current practice of disposing waste on a landfill without the capture of landfill gas and of using anaerobic lagoons without methane recovery and flaring to treat waste water does not

generate any revenue nor incur any extra investment cost. Thus a financial analysis to evaluate this option is not applicable, as there will be no return nor cost from its implementation.

To evaluate the proposed project, below we therefore apply Step 2 of the latest version of the "Tool for demonstration and assessment of additionality" to evaluate the economic attractiveness of the project with and without CDM financing.

Step 2a: Determine appropriate analysis method

According to the "Tool for the demonstration and assessment of additionality", if the project will generate financial or economic benefits other than CDM-related income and if the alternative to the CDM project activity does not include investments of comparable scale to the project, then Option III (of the methodology tool) must be used. As this is the case for the project, Option III is applied here.

The Alternatives presented are not commercially used in the area, or not common in Malaysia, so were not included in the analysis.

Step 2b: Option III - Application of benchmark analysis

The likelihood of development of this project, as opposed to the continuation of its baseline will be determined by comparing its Net Present Value (NPV) and Internal Rate of Return (IRR) with the benchmark of interest rates available to a local investor; i.e., those provided by local banks in the Host Country, which averages 3.8% for January, 2007 as in the referenced footnote.

Financial analysis conducted for the Project (see Annex 3 for the input details and Tables showing the results of the Financial Analysis) using assumptions that are the best cases from an investment decision point of view, shows that the IRR of the project without carbon finance is negative.

A financial analysis was undertaken using assumptions that are highly conservative from the point of view of analyzing additionality; i.e., the best case scenario IRR was calculated. It was assumed that the average waste rate at the project site was equal to 192 tonnes per day. Sales of compost product were assumed to be at current market prices, so the increased supply would not depress prices. These best case assumptions were inputted into the model and financial analyses to calculate the IRR.

The rate of return of 2006 Malaysia National Bonds， which is issued on Sep 1, is 3.8%. [5] A conservative risk factor of 2% would bring the project rate of return required to 5.8%. This would be the hurdle rate for the Project.

Step 2c: Calculation and comparison of financial indicators

The Table below shows the financial analysis for the project activity. As shown, the base case project IRR (without carbon) is negative, lower than the interest rates provided by local banks or government bonds in the Host Country.

Table B.1: Financial results of the project (Alternative 1) without carbon finance. NPV

[5] Source: "Citygroup Asia Economic Outlook and Strategy", 26 January 2007

uses 5% discount rate.

	without CER
Net Present Value (US $)	(1,431)
IRR (%)	0.13
Discount rate	5%

Summary of results of project analysis. Details in Annex 3 and will be made available to Validator.

Table B.2 Impact of CDM registration

	with CER
Net Present Value(US $)	3,148
IRR (%)	12.93
Discount Rate	5%

Assumptions:

- Discount rate: related to historical commercial lending fees are approx 3.8%. In addition a technology risk factor of 2% is taken into account, since the composting on such large scale and the associated technology used is new to the country and to local operators. These two factors add up to a 5.8% discount rate.
- Inflation: based on historical data (Source: World Economic Outlook (WEO) -- April 2004 -- Statistical Appendix pg. 222) an average inflation rate of 3.65 % has been assumed.
- Project duration: 10 years.
- Revenue streams: Taken into account are the expected revenues: sale of compost fertilizer. Investments: Taken into account are the composting plant, equipment and working capital.
- Costs: Taken into account are the associated operational expenses (mainly labour, energy costs, microbes, additives, etc.)

Sub-step 2d: Sensitivity analysis

Several parameters include technology, social-economy and investment costs has been evaluated. It is concluded that the investment costs are the only barrier for the project, as shown in Table B3.

Table B.3: Comparison of possible parameters as barriers.

Parameters	Barrier Indication	Reasons
Technology	Low	Composting technology has been designed and continuously improved over the past decades and is considered mature. For example BACKHUS from Germany has more than 20 years experience in the field. The technology has been proven and widely used in many countries.

Social	Low	As the composting process is designed such that there is no other discharge of solid waste or wastewater, it is considered environmental-friendly. Composting will minimize the solid waste EFB and wastewater POME generated from the mill, which otherwise creates pollution, by converting them into organic compost. This is in alignment with the Zero Waste Concept that is widely promoted now. In addition, the organic compost produced can be reapplied back to the plantation to combat soil degradation resulting from usage of high chemical fertilizer. Moreover, it helps to promote the yield of crops eventually. Therefore, it contributes to the local sustainable development.
Investment	High	The investment of such composting technology is high due to equipment, installation, construction of plants in a required large area with concrete floor and roofing, as well as microbes fortification etc.

Therefore, a sensitivity analysis was conducted by altering the following parameters:

- Increase in project revenue- Compost fertilizer selling price of 10%
- Reduction in running costs (Operational and Maintenance costs) of 10%
- Reduction in investment costs of 10%

Those parameters were selected as being the most likely to fluctuate over time. Financial analyses were performed altering each of these parameters by 10%, and assessing what the impact on the project IRR would be (see Table below). As can be seen, the project IRR remains lower than its alternative even in the case where these parameters change in favor of the project.

Table B.4: Sensitivity analysis

Scenario	**% change**	**IRR (%)**	**NPV $US**
Original		0.13	(1,431)
Increase in project revenue	10	1.65	(1,001)
Reduction in project costs	10	0.89	(1,225)
Reduction in investment costs	10	1.10	(1,096)

Note: NPV use 5% discount rate

Summary
It is therefore concluded that the proposed CDM project is unlikely to be financially attractive without CDM support.

Step 5: Assessment whether the identified baseline scenario is common practice

The existing solid waste disposal at landfill and POME wastewater treatment system at the mill is able to comply with the legal discharge standards as stipulated by the Department of Environment,

Malaysia. The open anaerobic pond system is the most common and standard practices at most palm oil mills in Malaysia. There is no legal requirement or financial incentive to compel the mill owners to implement other treatment options that will require additional investment. For Asia mill the most plausible baseline scenario for treatment of the wastewater is the continuation of the use of open anaerobic lagoons throughout the crediting period and the most plausible baseline for treating bioorganic waste is a managed landfill.

Step 6: Impact of CDM Registration

CDM Registration of this project activity overcomes the financial and technical barriers that have so far prevented investors with experience in aerobic co-composting waste treatment and bio-organic fertilizers to come together to build and operate a treatment facility which will eliminate methane emissions from the disposal of biomass and organic liquid wastes that represent business as usual at the Asia site. The experience brought by carbon investors together with their technology expertise and technical and financial resources will make possible the implementation of the proposed CDM project.

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (assessment and demonstration of additionality):

The determination of project scenario additionality is done using the latest version of the "Tool for the demonstration and assessment of additionality" agreed by Executive Board (Version 03), which follows the following steps:

Step 1. Identification of alternatives to the project activity consistent with current laws and regulations

Sub-step 1a. Define alternatives to the project activity:

The identified baseline alternatives are listed below. More details on the selection of the most realistic and credible baseline scenario can be found in Section B.4.

- **Alternative 1:**
  Continuation of current situation which solid waste EFB will be dumped in a unmanaged or managed site and wastewater POME processed with anaerobic lagoons and discharged into river.

- **Alternative 2:**
  Proposed project activity of co-composting the solid waste EFB and wastewater POME into organic compost, implemented without consideration of CDM revenues.

Sub-step 1b: Consistency with mandatory laws and regulations:

The only option that does not comply with regulatory requirements is the open burning of the wastes. Malaysia has banned uncontrolled open burning in palm oil industry.

The project will divert organic waste from waste piles or landfilling towards a composting plant. Instead of anaerobic conversion, resulting in – amongst others – methane production, the organic waste is aerobically degraded, producing only non-fossil CO_2, into a reusable product (compost). By converting organic waste from landfilling towards aerobic composting, landfill gas methane emissions are 100% prevented. The prevented methane emissions from the landfill and anaerobic wastewater treatment ponds that otherwise would occur are claimed as emission reductions.

AM0039 is used as the guideline for determining avoided methane emissions.

Preventing organic waste from landfilling prevents the production and escape of 100% of the methane emissions to the atmosphere. This amount is calculated by using the Multi Phase First Order Decay Model [6].

Outcome of Step 1b:

Malaysia has no regulations for collection of landfill gas from landfills in the country, as well as for the co-composting of EFB and wastewater.

Step 2. Investment Analysis

As detailed in Step 4 of the methodology ("Compare economic attractiveness of remaining alternatives"), the financial returns from the project activity do not meet the required IRR benchmark of 5.8%. There is a low return for the project, without including CDM financing, so project activity without CDM cannot be considered as financially attractive. The sensitivity analysis performed in Step 4 also shows that the project continues to achieve a sub-5.8% return even when revenue is costs decreased by 10%.

Step 3. Barrier Analysis

No barrier analysis will be conducted since the only real barrier to the project activity is an economic one and without the extra revenue from CER sales, this type of project would not proceed, as will be demonstrated in Step 4.

Step 4. Common Practice Analysis

Sub-step 4a. Analyse other activities similar to the proposed activity

---

[6] The Multi Phase First Order Decay Model is based on the available "Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site" provided by UNFCCC.

To date there has been limited development of composting projects using EFB in Malaysia. A number of companies were contacted to supply compost fertilizer and the LFGC database for competitor analysis was used to identify companies that were even remotely associated with the business. The Table below summarizes the activities that could be identified for compost and organic fertilizer activity in Malaysia:

Companies which have considered CDM

Company Name	Location	Production Rate (tonnes/a)	Current Status
Golden Hope Plantations Berhad (http://www.goldenhope.com)	Sabah	**None**	Plans to develop 5 compost plants under the CDM Program, no production at present. All compost for internal use. Among them, 4 compost plants projects have been registered in 14 Dec 2007 and 1 project has been registered in 17 Dec 2007.
MG BioGreen Sdn. Bhd. (http://www.microgreen.com.my)	Selangor Daruh Ehsan	**Not mentioned**	Company started 2002, patent for compost system 2004, and trying to sell technology, but only sale seems to be the CDM Project in Sabah. Its first small-scale CDM composting project has registered in 4 Nov 2007.

Companies which have not considered CDM

SEN Tech Sdn. Bhd. (http://www.sentech.com.my/Home/Profile.asp)	Selangor Daruh Ehsan	**None**	Announced a large plant for Selangor in March, 2003. Nothing has transpired since that time.

Asia Green Environmental Sdn.Bhd. (http://www.asiagreen.com.my/corporate_company.htm)	Kuala Lumpur, Malaysia	**18,000**	The pilot plant was constructed in Proton City, Tanjong Malim producing organic compost using available organic wastes, i.e. empty fruit bunches (EFB) .The company's novel waste management system was noticed by Bertam Holdings Plc by September 2001. In the year 2002, another listed company, Kulim (M) Berhad, one of the major plantation holder in Johor, acquired a sizable stake in Asia Green. With this partnership, Asia Green was able to build and operate its very first EFB & POME Waste Management Plant, adjacent to a 30 mt/hr palm oil mill, in Sedenak, Johor, under the banner of Kulim. This plant uses open windrowing, no cover, no hardening of surface, so leachate water is not collected and full aerobic composting may not be achieved.
OrganiGro Sdn Bhd	Perlis	**5,000**	The plant was established in 2001 for a production rate of 30,000 t/a compost using rice husk and molasses. The company has lost money every year and was restructured to invest in an EFB compost extension to their plant in 2006, utilizing the CDM Program to increase revenue, as trying to survive from only organic fertilizer revenue was impossible.

Reco Bio-Tech (M) Sdn. Bhd. (http://www.recobiotech.com)	Selangor, Malaysia	**no compost**	Produce soil conditioner, no compost.
Halex (M) Sdn.Bhd. (http://www.halex-group.com/halexm/mmain.htm)	Kuala Lumpur , Malaysia	**none**	Produce agricultural chemicals cotton , paper disposable and horticulture, may have some compost from the disposable paper products.
Farmcochem Sdn. Bhd. (http://www.farmcochem.com/)	Selangor Darul Ehsan , Malaysia	**none**	It was founded in 1984. The main products which they produce are paraquat and glyphosate.

All Cosmos Industries Sdn Bhd. (http://www.allcosmos.com/)	Johor, Malaysia	**about 50,000 in Malaysia**	It was established in 1999. The factory is sited on 6 acres of land in Pasir Gudang Industrial Estate in Johor, Malaysia and has a built-up area of some 10,000 square metres. Also, there are 2 plants in China.The annual production capacity is around 300,000 tonnes of bio-organic fertiliser.Through extensive research and development, they have created a series of bio-organic fertilisers that are available in pellet, powder and liquid form. Known as Real Strong bio-organic fertiliser, they are suitable for a broad spectrum of vegetables, fruit trees, oil palm trees, turf and paddy, among others. In September 12, 2002, they announced to invest to set up 5 big-organic plants. To date, no additional plants are invested or even planned. Stated on website that Cosmos "Operates the only bio-organic fertilizer plant in Malaysia" (this was in 2002), and only Asia Green has been constructed since that time.
Zenxin Agri-Organic Food (JB) Sdn. Bhd. (http://www.zenxin.com.my/html/company.php)	Selangor, Malaysia.	**unknown**	Zenxin Agriculture Sdn. Bhd. fertilizer division, was set up in year 2000. The build-up area of the factory is 10000 m^2 and it produces organic fertilizer from chicken dung using anerobic process. No more plants were built after 2000.

Kenso Corporation (M) Sdn Bhd (http://www.kensocorp.com/)	Selangor , Malaysia	**none**	Appears to be only a distributor of agricultural chemicals and fertilizers.
PPB Group Berhad (http://www.ppbgroup.com/ppb/2_business/2_2_1_palm.htm)	Kuala Lumpur, Malaysia	**none stated**	The oil palm plantation operations are held through PPB Oil Palms Berhad (PPBOP), a 55.7% subsidiary of PPB. PPBOP currently owns a total land bank of 363,238 hectares and nine palm oil mills in East Malaysia and Indonesia. Have quoted for supply of compost, but no mention of compost production on their website.

Sub-step 4b Discuss any similar options that are occurring

There are a number of small composting operations in the area, but they are only sporadic operations. This is the reason that EFB was only open burned a few years ago. The only commercial operation utilizing EFB as the primary composted material is the Asia Green plant in Sedenak, Johor. This plant was operating since 2003 and the company has actively promoted the business as a technology transfer, but has not succeeded in developing any other production plants. This operation is not necessarily a fully aerobic compost plant, and does not appear to have any ability to collect and treat excess water, even though they say that Palm Oil Mill Effluent is also treated in their facility. This plant is also integrated into an existing Palm Oil Mill and the compost is returned to the plantation if it cannot be sold on the market.

The other two major organic fertilizer manufacturers use mostly chicken dung in one case (Zenxin) and a mixture of animal wastes, seafood processing by products and seaweed (All Cosmos), so are not comparable to using only EFB as the compost material for commercial operations. The compost fertilizers from these two companies command a much higher price than the level that is achievable for the compost from this Project. These products have a niche market, in contrast to the mass market that must be established for large scale production of EFB compost. The Table above shows 6 new projects utilizing the CDM Program to produce these compost products, so the anticipated price for the products will not be a premium.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

>>

The project activity diverts organic waste from landfilling towards composting, where the baseline scenario is landfilling with the methane produced in the landfill totally released into the atmosphere.

POME from the Palm Oil mill also is treated first in anerobic ponds that remove most of the DOC from the wastewater before going to aerobic polishing ponds for final treatment before release to surface water. Collection and utilization of this methane is not practical since the site is isolated, and the mill boiler is fuelled by Mesocarp Fiber. The boiler also supplies steam to a steam turbine generator that supplies the mill and this project with all the electricity necessary for operations, so the methane cannot practically be used for power generation. There is no economic reason to install methane collection on the existing anerobic ponds to collect and flare the gas.

This situation fits the requirements of AM 0039, version1.

The following conditions apply:

-the waste going into the composting plant would be landfilled in the baseline and methane gas would be released into the atmosphere. So far, there is no consideration of capturing methane from such EFB landfills. The methane emissions from the landfill would thus be emitted into the atmosphere in the baseline.

The composting meets the following operational requirements:

·The organic material is fully aerated (aerobic process) during the composting process

- conditions required to apply the multi-phase model:

·the net inputs to the composting process are known and can be monitored during the process. Values to be utilized in the Multi-Phase Model are determined for local substrates (EFB) or IPCC default values are used (for the POME stream).

The emission reductions can be calculated using the following formula:

$ER_y = BE_y - PE_y - LE_y$

Where:
ER_y: Emissions Reductions (t CO_2e) in year y
BE_y: Emissions in the baseline scenario (t CO_2e) in year y
PE_y: Emissions in the project scenario (t CO_2e) in year y
LE_y: Leakage emissions (t CO_2e) in year y

B.6.2. Data and parameters that are available at validation:

(Copy this table for each data and parameter)

Data / Parameter:	$B_{,0}$
Data unit:	Kg CH_4 per Kg COD
Description:	Maximum methane producing capacity of the inlet effluent
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories, Volume 5, Chapter 6, Table 6.2 AM0039 version 1, page 8
Value applied:	0.21 (default value)
Justification of the choice of data or description of measurement methods and procedures actually applied :	Conservative value
Any comment:	

Data / Parameter:	DOC_f
Data unit:	fraction
Description:	Degradable Organic Carbon dissimilated to landfill gas
Source of data used:	AM0039 version 1
Value applied:	0.77 (default value)
Justification of the choice of data or description of measurement methods and procedures actually applied :	EFB will completely degrade in less than one year, so the lignin content is not inhibiting the degradation to biogas of the EFB.
Any comment:	

Data / Parameter:	Φ
Data unit:	Fraction
Description:	Model Correction Factor
Source of data used:	AM0039 version 1
Value applied:	0.9
Justification of the choice of data or description of measurement methods and procedures actually applied :	Normal Practice
Any comment:	

Data / Parameter:	*OX*
Data unit:	Fraction
Description:	Oxidation Factor (amount of methane oxidised in the soil or other material covering the waste
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories Volume 5, Chapter 3, Table 3.2
Value applied:	0
Justification of the choice of data or description of measurement methods and procedures actually applied :	OX is determined by the following two ways: (1) Conduct a site visit at the solid waste disposal site in order to assess the type of cover of the solid waste disposal site. Use the IPCC 2006 Guidelines for National Greenhouse Gas Inventories for the choice of the value to be applied. (2) Use 0.1 for managed solid waste disposal sites that are covered with oxidizing material such as soil or compost. Use 0 for other types of solid waste disposal sites. Since the landfill in baseline scenario can be considered as a managed landfill without cover, the *OX* in this case is 0.
Any comment:	

Data / Parameter:	*MCF*
Data unit:	Factor
Description:	methane correction factor
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories Volume 5, Chapter 3, Table 3.1
Value applied:	1.0
Justification of the choice of data or description of measurement methods and procedures actually	Use the following values for MCF: • 1.0 for **anaerobic managed solid waste disposal sites**. These must have controlled placement of waste (i.e., waste directed to specific deposition areas, a degree of control of scavenging and a degree of control of fires) and will include at least one of the following: (i) cover material; (ii) mechanical

applied :	compacting; or (iii) leveling of the waste. • 0.5 for **semi-aerobic managed solid waste disposal sites**. These must have controlled placement of waste and will include all of the following structures for introducing air to waste layer: (i) permeable cover material; (ii) leachate drainage system; (iii) regulating pondage; and (iv) gas ventilation system. • 0.8 for **unmanaged solid waste disposal sites – deep and/or with high water table**. This comprises all SWDS not meeting the criteria of managed SWDS and which have depths of greater than or equal to 5 meters and/or high water table at near ground level. Latter situation corresponds to filling inland water, such as pond, river or wetland, by waste. • 0.4 for **unmanaged-shallow solid waste disposal sites.** This comprises all SWDS not meeting the criteria of managed SWDS and which have depths of less than 5 meters. In the proposed project, the landfill in baseline scenario can be considered as a managed landfill, since most of the criteria indicated in the note of table Annex 3.1 is existing. The waste at the landfill generally has a height of more than 5 meters and thus can be considered as a deep landfill, there is placement of waste in specific areas, no scavenging, control of fires and a bulldozer is used to level the waste piles and do some compacting.
Any comment:	

Data / Parameter:	DOC_j
Data unit:	Fraction
Description:	Fraction of degradable organic carbon (by weight) in the waste type *j*
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories Volume 5, Chapter 3, Table 2.4 and 2.5
Value applied:	20% (wet weight)
Justification of the choice of data or description of measurement methods and procedures actually applied :	Default value given by "Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site"
Any comment:	

Data / Parameter:	K_j
Data unit:	-
Description:	Is the decay rate for the waste type *j*
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories, Volume 5, Table 3.3
Value applied:	0.17
Justification of the choice of data or description of	In the site of proposed project, the mean annual temperature is 27.7 °C, and mean annual precipitation (MAP) is more than 2000mm. The default value defined by the "Tool to determine methane emissions avoided from dumping

measurement methods and procedures actually applied :	waste at a solid waste disposal site" is applied.
Any comment:	Local value will be applied in the crediting period after it has been accepted by UNFCCC during verification.

Data / Parameter:	GWP_{CH4}
Data unit:	tCO_2e
Description:	Global Warming Potential of methane
Source of data used:	AM0039 version1
Value applied:	21
Justification of the choice of data or description of measurement methods and procedures actually applied :	This is the current crediting period GWP parameter for CH_4
Any comment:	

Data / Parameter:	GWP_{N2O}
Data unit:	tCO_2e
Description:	Global Warming Potential of Nitrous Oxide
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value applied:	310
Justification of the choice of data or description of measurement methods and procedures actually applied :	This is the current crediting period GWP parameter for N_2O
Any comment:	

Data / Parameter:	NCV_i
Data unit:	MJ/fuel quantity
Description:	Net Calorific Value of fuel type I used in project activity
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories Volume 2, Chapter 1, Table 1.2
Value applied:	43 (Net Calorific Value of Diesel)
Justification of the choice of data or description of	The only fuel used in the project activity is diesel

measurement methods and procedures actually applied :	
Any comment:	

Data / Parameter:	EF_i
Data unit:	$KgCO_2$ per GJ
Description:	CO_2 Emission Factor for fuel type i
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories Volume 2, Chapter 1, Table 1.4
Value applied:	74.1 (Emission factor of diesel)
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	

Data / Parameter:	$OXID_{,i}$
Data unit:	factor
Description:	Oxidation factor of fuel type i
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories Volume 2, Chapter 1, Table 1.4
Value applied:	0.99
Justification of the choice of data or description of measurement methods and procedures actually applied :	Default value
Any comment:	

Data / Parameter:	f_d
Data unit:	Fraction
Description:	Fraction of anaerobic degradation due to depth
Source of data used:	Default values given in AM00039
Value applied:	0.5
Justification of the choice of data or description of measurement methods and procedures actually applied :	The depth of the anaerobic POME treatment ponds in the project location is 4.5meters. Therefore the default value used is 0.5
Any comment:	

Data / Parameter:	f_t
Data unit:	Fraction
Description:	Fraction of anaerobic degradation due to temperature
Source of data used:	Department of Meteorology
Value applied:	0.82 (The value has been calculated taking the temperature of 27.7 ^{o} C in the region)
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	

B.6.3 Ex-ante calculation of emission reductions:

Baseline emissions

The following types of baseline emissions will be accounted under this methodology.

a) Methane (CH_4) emissions from waste water in anaerobic lagoons or open storage tanks;
b) Methane (CH_4) emissions from decay of bioorganic solid waste in disposal sites;
c) CO_2 emissions from transportation of organic wastewater and bioorganic solid waste;
d) CO_2 emissions from fossil fuels used for energy requirements and
e) CO_2 emissions from grid electricity consumption.

Total baseline emissions are expressed as:

$$BE_y = BE_{CH4,WW,y} + BE_{CH4,SW,y} + BE_{CO2,Trans,y} + BE_{CO2,FF,y} + BE_{CO2,Elec,y}$$

Where:

BE_y is the total baseline emissions during the year y, (tCO_2e)

$BE_{CH4,WW,y}$ is the baseline methane emissions from existing open lagoon or open storage tanks during the year y (tCO_2e)

$BE_{CH4,SW,y}$ is the baseline methane emissions from decay of bio-organic solid waste during the year y(tCO_2e)

$BE_{CO2,Trans,y}$ is the baseline CO_2 emissions from transportation of organic wastewater and bioorganic solid waste during the year y (tCO_2e)

$BE_{CO2,FF,y}$ is the baseline CO_2 emissions from use of fossil fuels during the year y (tCO_2)

$BE_{CO2,Elec,y}$ is the baseline CO_2 emissions from grid electricity consumption during the year y (tCO_2)

The above emissions shall be calculated as explained below:

*(a) Methane (CH_4) emissions from wastewater in open storage systems (**$BE_{CH4,WW,y}$**)*

The baseline methane emissions from anaerobic lagoons or storage tanks are estimated based on the chemical oxygen demand (COD) of the effluent that would enter the lagoon in the absence of the project activity, the maximum methane producing capacity (Bo) and a methane conversion factor (MCF) that expresses what proportion of the effluent would be anaerobically digested in the open lagoons. These CH_4 emissions from wastewater are calculated according to the IPCC Guidelines as follows:

$$BE_{CH4,WW,m} = COD_{available,m} * B_o * MCF_{baseline} * GWP_{CH4}$$

Where:

$BE_{CH4,WW,m}$ is the baseline monthly methane emissions from wastewater (tCO_2e)

$COD_{available,m}$ is the monthly Chemical Oxygen Demand available for conversion which is equal to the monthly COD of the wastewater used for co-composting $COD_{baseline,m}$ plus COD carried on from the previous month (tCOD)

$COD_{baseline,m}$ is the monthly Chemical Oxygen Demand of effluent entering anaerobic lagoons or storage tanks (measured in the project activity) (tCOD), 50 kg/t for this calculation

B_o is the maximum methane producing capacity of the inlet effluent (tCH_4/tCOD)

$MCF_{baseline}$ is the methane conversion factor of the baseline storage system (fraction), 0.367 for this calculation

GWP_{CH4} is the Global Warming Potential of methane, default value 21

$COD_{baseline,m}$ is to be directly measured in the project as the baseline activity level since the effluent that goes into the anaerobic lagoon or storage tanks in the baseline situation is the same as the one that goes into the project.

$COD_{baseline,m}$ is calculated as the product of $COD_{baseline,m}$ concentration (kgCOD/m3) in the wastewater input to the project and the flow rate F_{dig} (m_3/month).

In case there is an effluent from the lagoons where the wastewater does not reside for at least 30 days in the baseline, $COD_{baseline}$ values should be adjusted by multiplying $COD_{baseline}$ by the following factor AD:

$$AD = 1 - \left(\frac{COD_{a,out}}{COD_{a,in}} \right)$$

Where:

$COD_{a,out}$ is the COD that leaves the lagoon with the effluent that does not reside for at least 30 days

$COD_{a,in}$ is the COD that enters the lagoon

$COD_{a,out}$ and $COD_{a,in}$ should be based on one year historical data

The amount of organic matter available for conversion to methane $COD_{available,m}$ is assumed to be equal to the amount of organic matter produced during the month ($COD_{baseline,m}$ input to the project) plus the organic matter that may remain in the system from previous months.

The amount of organic matter consumed during the month is equal to the amount available for conversion
$COD_{available,m}$ multiplied by $MCF_{monthly}$.

The amount of organic matter carried over from one month to the next equals to the amount available for conversion minus the amount consumed and minus the amount removed from the anaerobic lagoon or storage tank. In the case of the emptying of the anaerobic lagoon or storage tank, the accumulation of organic matter restarts with the next inflow.

The default IPCC value for B_o, the maximum amount of CH_4 that can be produced from a given quantity of wastewater, is 0.25 kg CH_4/kg COD. Taking into account the uncertainty of this estimate, project participants should **use a value of 0.21 kg CH_4/kg COD as a conservative assumption for B_o**. (reference to AM0039 version 1)

$MCF_{baseline,m}$ is estimated as the product of the fraction of anaerobic degradation due to depth (fd) and the fraction of anaerobic degradation due to temperature (f t):

$$MCF_{baseline\ m} = f_d * f_{t\ monthly} * 0.89$$

Where:

f_d is the fraction of anaerobic degradation due to depth as per Table 1. **This project has existing anaerobic ponds with a depth 4.5m, so the value used will be 0.5**

f_t is the fraction of anaerobic degradation due to temperature. **The average annual temperature is 27.7 ^oC, as reported by the local weather meteorological station. For verification, monthly values will be used, but for this estimation, 27.7 ^oC was used as the annual average, resulting in a factor of 0.82**

0.89 is an uncertainty conservativeness factor (for an uncertainty range of 30% to 50%) to account for the fact that the equation used to estimate $f_{t,monthly}$ assumes full anaerobic degradation at 30 ºC.

	Deep > 5m	Medium depth 1–5m	Small depth <1m
Fraction of degradation under anaerobic conditions due to depth of anaerobic lagoons or storage tank	70%	50%	0

$f_{t,\ monthly}$ is calculated as follows:

$$f_{t,\ monthly} = \exp\left[\frac{E \cdot (T_2 - T_1)}{R \cdot T_1 \cdot T_2}\right]$$

Where:

$f_{t,monthly}$ anaerobic degradation factor due to temperature

E Activation energy constant (15,175 cal/mol)

T2 Ambient temperature (Kelvin) for the climate (300.86 K based on 27.7 C average temp)

T1 303.16 (273.16° + 30°)

R Ideal gas constant (1.987 cal/ K mol).

The factor '$f_{t,,monthly}$' represents the proportion of organic matter that is biologically available for conversion to methane based upon the temperature of the system. The assumed temperature is equal to the ambient temperature. The value of ft to be used cannot exceed unity.

Monthly values for $f_{t,,monthly}$ are calculated as follows:

(1) The monthly average temperature for the area is obtained from published national weather service information.

(2) Monthly temperatures are used to calculate a monthly van't Hoff – Arrhenius '$f_{t,,monthly}$' factor above.

A minimum temperature of 10 °C is used. Months where the average temperature is less than 10 ºC, $f_{t,monthly}$ = 0. The value of $f_{t,monthly}$ to be used cannot exceed unity.

It is then possible to calculate the MCF both monthly and annual.

Annual MCF can be estimated from the following equation:

$$MCF_{annual} = \frac{\sum_{m=1}^{12} CH_{4m}}{B_o \cdot \sum_{m-1}^{12} COD_{baseline,m}}$$

Monthly baseline CH_4 emissions (***$BE_{CH4,WW,m}$***) shall be aggregated into annual emissions as follows:

$$BE_{CH4\,WW,y} = \sum_{m-1}^{12} BE_{CH4,WW,m}$$

Where:

$BE_{CH4,WW,y}$, is the estimated annual methane production in tCO_2e, during the year *y*

$BE_{CH4,WW,m}$ is the estimated monthly methane production in tCO_2e

For the project MCF has been calculated to be 0.5*0.82*0.89=0.367

(b) Methane emissions from decay of bioorganic solid waste in disposal sites($BE_{CH4,SW,y}$)

The amount of methane that is generated each year is calculated for each year with a multi-phase model. The model is based on a first order decay equation [3]. It differentiates between the different types of waste *j* with respectively different decay rates *k*j (fast, moderate, slow) and fraction of degradable organic carbon (DOC_j). The model calculates the methane generation based on the actual waste streams $A_{j,x}$ disposed in the most recent year (y) and all previous years since the project start (x=1 to x=y). The amount of methane produced in the year *y* (MB_y) is calculated as follows:

$$BE_{CH4,SW,y} = \left[\phi \cdot \frac{16}{12} \cdot F \cdot DOC_f \cdot MCF \cdot GWP_{CH4} \cdot \sum_{x=1}^{y} \sum_{j=A}^{D} A_{j,x} \cdot DOC_j \cdot \left(1 - e^{-kj}\right) \cdot e^{-kj(y-x)} \right] - MD_{reg}$$

Where:

$BE_{CH4,SW,y}$ is the methane produced in the landfill in the absence of the project activity in year y(tCH_4)

Φ is the model correction factor (**default 0.9**) to correct for the model-uncertainties

F is the fraction of methane in the landfill gas (**default value of 0.5 used**)

DOC_j is the per cent of degradable organic carbon (by weight) in the waste type j (**0.3 for EFB**)

DOC_f is the fraction of DOC dissimilated to landfill gas (**default value of 0.77 used**)

MCF is the Methane Correction Factor (**value used 1-managed landfill**)

$A_{j,x}$ is the amount of organic waste type j prevented from disposal in the landfill in the year x (tonnes/year)

k_j is the decay rate for the waste stream type j(determined through independent research)

j is the waste type distinguished into the specific type or three waste categories, as above

x is the year during the crediting period: x runs from the first year of the first crediting period (x=1) to the year for which emissions are calculated (x=y)

y is the year for which LFG emissions are calculated

$MD_{y,reg\,y}$
Methane that would be destroyed or removed in the year "y" for safety or legal regulation. In cases where regulatory or contractual requirements do not specify MDreg,y, an Adjustment Factor (AF) shall be used and justified, taking into account the project context. In doing so, the project participant should take into account that some of the methane generated by the landfill may be captured and destroyed to comply with other relevant regulations or contractual requirements, or to address safety and odour concerns.

$MD_{reg,y} = MB_y * AF$

Where:

AF is Adjustment Factor for MB_y (%)

AF is defined as the ratio of the destruction efficiency of the collection and destruction system mandated by regulatory or contractual requirement to that of the collection and destruction system in the project activity.

The 'Adjustment Factor' will be revised at the start of each new crediting period taking into account the amount of GHG flaring that occurs as part of common industry practice and/or regulation at that point in the future.

At the present time, most landfills in Malaysia do not collect landfill gas, and consequently do not burn it, so the AF is considered zero for the first crediting period.

GWP_{CH4}
Global Warming Potential for methane (value of 21)

The IPCC default values[6] used for the variables in the equation are as follows:

[6] IPCC Guidelines for National GHG Inventories, Reference Manual, Chapter 6, WASTE and Chapter 4, Agriculture.

Methane correction factor – 1.0, since the EFB is in a pile higher than 5m placed in pre-determined areas, levelled periodically and compacted.

Fraction of DOC disseminated to LFG – 0.77

Fraction of CH_4 in LFG – 0.5

Model Correction Factor (φ)

Oonk et el. have validated several landfill gas models based on 17 realized landfill gas projects.[7] The mean relative error of multi-phase models was assessed to be 18%. Given the uncertainties associated with the model and in order to estimate emission reductions in a conservative manner, a discount of 10% should be applied to the model results, i.e. $\varphi = 0.9$

The amount of organic waste type *j* ($A_{j,x}$) is calculated based on the total amount of waste collected in the year x (Ax) and the fraction of the waste type in the samples ($p_{n,j,x}$), as follows:

$$A_{j,x} = A_x \cdot \frac{\sum_{n=1}^{z} P_{n,j,x}}{z}$$

where:

$A_{j,x}$ is amount of organic waste type j prevented from disposal in the year x (tonnes/year)

A_x is amount of total organic waste collected during the year x (tonnes/year)

$p_{n,j,x}$ is fraction of the waste type j in the sample n collected during the year x

z is number of samples taken during the year x

Calculation of F

The project participant shall determine *F* with the following order of preference**:**

1. Measure *F* on an annual basis as a monitoring parameter, at a landfill in the proximity of the treatment plant, receiving comparable waste as the treatment plant receives.

2. Measure *F* once prior to the start of the project activity at a landfill in the proximity of the treatment plant, receiving comparable waste as the treatment plant will receive.

3. In case there is no access to a landfill, the project participants should apply the conservative default value of 0.5, being the lower end of IPCC range of 0.5 – 0.6.

[7] Oonk, Hans et al.:Validation of landfill gas formation models. TNO report. December 1994

For the *ex-ante* calculations, an F value of 0.5 will be used. For actual calculations, actual methane concentrations will be used, if available at local landfills.

(c) CO_2 emissions from transportation of organic wastewater and bioorganic solid waste ($BE_{CO2,Trans,y}$)

The baseline emissions from transportation are to be calculated using distance traveled by trucks and the fuel emission factor, as follows:

$$BE_{CO2,Trans,y} = \sum_i N_{vehicles,i,y} \cdot Dist_{i,y} \cdot FC_{i,Trans} \cdot NCV_i \cdot EF_{CO2,i}$$

Where:

$N_{vehicles,i,y}$	is the number of vehicle trips used for transportation, with similar loading capacity
$Dist_{i,y}$	is the average distance per trip travelled by transportation vehicles type *i* in the baseline scenario during the year *y* (km)
FC_i	is the vehicle fuel consumption in volume or mass units per km for vehicles type *i*
NCV_i	is the net calorific value of fuel type *i* in TJ per volume or mass units
$EF_{CO2,i}$	is the CO_2 emission factor of the fossil fuel type *i* used in transportation vehicles, (tCO_2e/TJ)

The CO_2 emissions of the project transportation in the baseline are considered to be zero as the EFB piled at the mill and the wastewater is piped into the lagoon.

(d) CO_2 emissions from fossil fuels used for energy requirements ($BE_{CO2,FF,y}$)

CO_2 emissions from fossil fuel used in the baseline for energy requirements such as heating shall be calculated as follows:

$$BE_{CO2,FF,y} = FC_{i,y} \cdot NCV_i \cdot EF_{CO2,i} \cdot OXID_i$$

Where:

$FC_{i,y}$	is the baseline fossil fuels consumed of type *i* for energy requirements during the year *y* in mass of volume units
NCV_i	is the Net Calorific Value (energy content) in TJ of fuel type *i*, per mass unit or volume unit
$EF_{CO2,I}$	is the CO_2 emission factor per unit of energy of the fuel *i* (tCO_2e/TJ)
$OXID_i$	is the oxidation factor of the fuel (see page 1.29 in the 1996 Revised IPCC Guidelines for default values)

Where available, local values of $\boldsymbol{NCV_i}$ and $\boldsymbol{EF_{CO2,i}}$ should be used. If no such values are available, country-specific values (see e.g. IPCC Good Practice Guidance) are preferable to IPCC world-wide default values.

Emissions in the baseline from the use of fossil fuels are considered to be zero as there are no fossil fuels currently being used for energy requirements

(e) CO_2 emissions from grid electricity consumption ($BE_{CO2,Elec,y}$)

In case electricity is consumed for energy requirements in the baseline, CO_2 emissions from electricity shall be calculated as follows:

$$BE_{CO2,Elec,y} = EC_y \cdot EF_{GridElec,y}$$

Where:

EC_y	is the baseline electricity consumption during the year y (MWh)
$EF_{GridElec,y}$	is the grid electricity emission factor for the year y (tCO_2/MWh)

Emissions from grid electricity consumption in the baseline are zero as the mill is not connected to the electricity grid

Baseline Emissions for POME:

Year	A	B	C	D	E	F=Emissions for POME
	Q_{WW} (m^3/yr)	$COD_{WW,untreated}$ (kg COD/m^3)	$B_{o,ww}$ (default value)	$MCF_{baseline}$	GWP_{CH4}	A☒B☒C☒D☒E /1000 (tCO_2e)
2008 (2 months)	1,800	64.646	0.21	0.367	21	188
2009	64,800	64.646	0.21	0.367	21	6,781
2010	64,800	64.646	0.21	0.367	21	6,781
2011	64,800	64.646	0.21	0.367	21	6,781
2012	64,800	64.646	0.21	0.367	21	6,781
2013	64,800	64.646	0.21	0.367	21	6,781
2014	64,800	64.646	0.21	0.367	21	6,781
2015	64,800	64.646	0.21	0.367	21	6,781
2016	64,800	64.646	0.21	0.367	21	6,781
2017	64,800	64.646	0.21	0.367	21	6,781
2018 (10 months)	45,000	64.646	0.21	0.367	21	4,709

Baseline Emissions for EFB

Year	Amount of fresh EFB Placed(tons)	Baseline Emissions for EFB ($t\ CO_2\ e$)
2008 (2 months)	7,920	2,403
2009	47,520	16,442
2010	47,520	28,287
2011	47,520	38,280
2012	47,520	46,711
2013	47,520	53,824
2014	47,520	59,824
2015	47,520	64,887
2016	47,520	69,158
2017	47,520	72,762
2018 (10 months)	39,600	73,399

Project emissions

The project emissions in year *y* are expressed as:

$PE_y = PE_{N2O,Comp,y} + PE_{CH4,Comp,y} + PE_{CH4,Bww,y} + PE_{CO2,Trans,y} + PE_{CO2,FF,,y} + PE_{CO2,Elec,y}$

where:

PE_y is the project emissions during the year y (tCO_{2e})

$PE_{N2O,Comp,y}$ is the N_2O emissions from composting of bio-organic waste in year y(tCO_{2e})

$PE_{CH4,Comp,y}$ is the CH_4 emissions from composting of bio-organic waste in year y (tCO2e)

$PE_{CH4,B,ww,y}$ is the CH_4 emissions from leaked wastewater discharged after the project activity in year y (tCO_2e)

$PE_{CO2,Trans,y}$ is the CO_2 emissions from transportation in the project situation during year y (tCO_2)

$PE_{CO2,FF,y}$ is the CO_2 emissions from use of fossil fuels in the project during year y (tCO_2)

$PE_{CO2,Elec,y}$ is the CO_2 emissions from grid electricity consumption in the project situation during year y (tCO_2)

The above emissions shall be calculated as explained below:

(a) N_2O emissions from composting ($PE_{N20,Comp,y}$)

$PE_{N20,Comp,y} = Q_{Compost,\ ,y} * EF_{N2O,Comp} * GWP_{N2O}$

where:

$Q_{Compost,\ ,y}$ is the total quantity of compost produced during year *y*, (tons of compost)

$EF_{N2O,Comp}$ is the emission factor for N_2O emissions from composting process (tN_2O/ton of compost)

GWP_{N2O} is the global warming potential of N_2O, default value 310

Based upon Schenk [8]and others, a total loss of 42 mg N_2O-N per kg composted dry matter can be expected (from which 26.9 mg N_2O during the composting process). The dry matter content of compost is around 65%.

Based on these values, a default emission factor of 0.043 kg N_2O per tonne of compost was used.[9] The emissions of N_2O are estimated as follows:

Calculated amounts are for 23,760 tonnes compost in each year of the crediting periods.

Emissions from composting:

Year	**Amount of Compost (tons)** (A)	**Default N_2O Emission Factor** (B)	**Default Global Warming Potential of N_2O** (C)	**Emissions from composting(tCO_2e)** (A*B*C)/1000
2008 (2 months)	3,960	0.043	310	53
2009	23,760	0.043	310	317
2010	23,760	0.043	310	317
2011	23,760	0.043	310	317
2012	23,760	0.043	310	317
2013	23,760	0.043	310	317
2014	23,760	0.043	310	317
2015	23,760	0.043	310	317
2016	23,760	0.043	310	317
2017	23,760	0.043	310	317
2018 (10months)	19,800	0.043	310	264

(b)CH_4 emissions from composting ($PE_{CH4,Comp,y}$):

During the composting process, aerobic conditions are possibly neither completely reached in all

[8] Manfred K. Schenk, Stefan Appel, Diemo Daum, "N_2O emissions during composting of organic waste", Institute of Plant Nutrition University of Hannover, 1997

[9] Assuming 650 kg dry matter per ton of compost and 42 mg N_2O-N, and given the molecular relation of 44/28 for N_2O-N_2, an emission factor of 0.043 kg N_2O / tonne compost results.

areas nor at all times. Pockets of anaerobic conditions – isolated areas in the composting heap where oxygen concentrations are so low that the biodegradation process turns anaerobic – may occur. The emission behaviour of such pockets is comparable to the anaerobic situation in a landfill. This is a potential emission source for methane similar to anaerobic conditions which occur in unmanaged landfills. Through predetermined sampling procedures the percentage of waste that degrades under anaerobic conditions can be determined. Using this percentage, project methane emissions from composting are calculated as follows:

$PE_{CH4,Comp,y} = PE_{CH4,Anaerobic,y} * GWP_{CH4} * S_{a,y}$

where:

$PE_{CH4,Anaerobic,}$ is the quantity of methane that would be generated from anaerobic pockets in composting process, during year *y*(t CH_4)

GWP_{CH4} is the global warming potential of CH_4, default value 21

$S_{a,y}$ is the share of the waste that degrades under anaerobic conditions in the composting Plant during the year *y* (%)

The amount of methane that is generated in anaerobic pockets ($PE_{CH4,Anaerobic}$) is calculated for each year with a multi-phase model. The model is based on a first order decay equation [3]. It differentiates between the different types of waste j with respectively different decay rates kj (fast, moderate, slow) and fraction of degradable organic carbon (DOC_j).The model calculates the methane generation based on the actual waste streams $A_{project,j,x}$ disposed in the most recent year (y) and all previous years since the project start (x=1 to x=y).The amount of methane produced is calculated as follows:

$$PE_{CH4,\ Anaerobic,\ y} = \Phi \cdot \frac{16}{12} \cdot F \cdot DOC_f \cdot MCF \cdot GWP_{CH4} \cdot \sum_{x=1}^{y} \sum_{j=A}^{D} A_{project,j,x} \cdot DOC_j \cdot (1 - e^{-kj}) \cdot e^{-kj\,(y-x)}$$

Project participants should use 0.8 as default MCF, unless they can demonstrate that the project – scenario is an aerobic composting of the solid biomass waste with a much lower MCF value.

Calculation of $S_{a,y}$

$S_{a,y}$ is determined by a combination of measurements and calculations. Bokhorst et al [10]and Richard et al[11] show that if oxygen content is below 5% - 7.5%, aerobic composting processes are replaced by

[10] Jan Bokhorst. Coen ter Berg – Mest & Compost Behandelen beoordelen & Toepassen (Eng: Manure & Compost – Treatment,
judgment and use), Louis Bolk Instituut, Handbook under number LD8, October 2001

[11] Tom Richard, Peter B. Woodbury, Cornell composting, operating fact sheet 4 of 10, Boyce Thompson Institute for Plant Research at Cornell University Cornell University

anaerobic processes. To determine the oxygen content during the process, project participants shall measure the oxygen content according to a predetermined sampling scheme and frequency.

These measurements should be undertaken for each year of the crediting period and recorded each year. The percentage of the measurements that show an oxygen content below 10% is presumed to be equal to the share of waste that degrades under anaerobic conditions (i.e. that degrades as if it were landfilled), hence the emissions caused by this share are calculated as project emissions *ex-post* on an annual basis:

$S_a = SOD / S_{total}$

where:

SOD is the number of samples per year with an oxygen deficiency (i.e. oxygen content below 10%)

S_{total} is the total number of samples taken per year, where Stotal should be chosen in a manner that ensures the estimation of Sa with 20% uncertainty at a 95% confidence level.

(c) CH_4 emissions from the leaked wastewater ($PE_{CH4,bww,y}$)

Projects such as composting will usually have no wastewater discharge but there is a possibility that a small quantity of leaked wastewater is collected from windrows or as a balance of waste water and this leak wastewater may cause CH_4 emissions.

CH_4 emissions from leak and/or balance of waste water shall be calculated as follows.

$$PE_{CH4,BWW,y} = COD_{outlet,total,y} \cdot B_o \cdot MCF_{outlet} \cdot GWP_{CH4}$$

Where:

$PE_{CH4,BWW,y}$ is the project methane emissions from wastewater during the year *y* (tCO_2e)

$COD_{outlet,total,y}$ is the outlet total COD of the wastewater during the year *y* (tCOD)

B_o is the outlet maximum methane producing capacity of wastewater (tCH_4/tCOD)

MCF_{outlet} is the methane conversion factor of the storage system (fraction)

GWP_{CH4} is the Global Warming Potential of methane

MCF_{outlet} is to be estimated in the same manner a that of $MCF_{baseline,m}$ in the baseline.

(d)CO_2 emissions from transportation ($PE_{CO2,Trans,y}$):

The project emissions from transportation are to be calculated using the total distance and IPCC default values for transportation fuel, as follows:

$PE_{CO2,Trans,y} = \sum N_{vehicles,i,y} * Dist_{i,y} * FC_i * NCV_i * EF_{CO2,i}$

Where:

$N_{vehicles,i,y}$	is the number of trips used for transportation, with similar loading capacity
$Dist_{i,y}$	is the average distance per trip traveled by transportation vehicles type *i* in the project scenario in the year *y* (km)
FC_i	is the vehicle fuel consumption in volume or mass units per km for vehicle type *i*
NCV_i	is the net calorific value of fuel type *i* in TJ per volume or mass units
$EF_{CO2,i}$	is the CO_2 emission factor of the fossil fuel type *i* used in transportation vehicles

Project emissions from transportation in the project situation ($PE_{CO2,Trans,y}$):

All the EFB will be transported from the mill to the composting plant:
Number of vehicles trips used for transporting EFB : 4,840 (10 tonnes/truck; 48,400 tonnes EFB – EFB has moisture content of 50%)
Distance travelled : 0.5 km + 0.5 km
Fuel consumption : 32.85 litre/100 km [13]
Density of diesel: 0.85 kg/litre
Calorific Value of diesel : 43 MJ/kg
EF (Emission Factor) of diesel : 74.1 kg/GJ
Emissions = 4,840*1*0.3285*0.85*43*74.1/1000000 = 4.31 tonnes CO_2e (per year)

Fuel required to transport compost to the plantation is estimated
Yearly amount of compost produced = 23,760 tonnes
Number of vehicles trips used for transporting EFB = 23,760 / 5 = 4,752
Average distance travelled : 20km (based on conservative estimates of average distance of plantation to the mill considering an average FFB production of 25MT/ha[12])
Fuel consumption : 32.85 litre/100 km [13]
Density of diesel: 0.85 kg/litre
Calorific Value of diesel : 43 MJ/kg
EF (Emission Factor) of diesel : 74.1 kg/GJ

Emissions = 4,752*20*0.3285*0.85*43*74.1/1000000 = 84 tonnes CO_2e (per year)

(e)CO_2 emissions from fossil fuel used in the project for energy requirements($PE_{CO2,FF,y}$)

---

[12] Economic Feasibility of Organic Palm Oil Production in Malaysia 2004.

[13] Energy Use in the Transportation Sector of Malaysia – Final Report 2005

CO_2 emissions from fossil fuel used in the project for energy requirements such as heating shall be calculated as follows:

$PE_{CO2, FF,y} = FC_{i,project,y} * NCV_i * EF_{CO2,i} * OXID_i$

where:

$FC_{i,project,y}$ is the fossil fuels consumed of type i for energy requirements during the year *y* in mass or volume units

NCV_i is the Net Calorific Value(energy content) in TJ of fuel type *i*,per mass unit or volum unit

$EF_{CO2,i}$ is the CO_2 emissions factor of the fuel *i* (tCO_2e/TJ)

$OXID_i$ is the oxidation factor of the fuel (see page 1.29 in the 1996 revised IPCC Guidelines for default values)

Where available, local values of NCV_i and $EF_{CO2,i}$ should be used. If no such values are available,country-specific values(see e.g. IPCC Good Practice Guidance) are preferable to IPCC world-wide default values.

IPCC default values are used for the net calorific values and CO_2 emission factors

Table Values for emissions calculation related to fossil fuel used on-site

Parameter	**Description**	**Value**
$FC_{i,project,y}$	Fuel (diesel)consumption (ltr.) on site in year y	18,250 ltr.(One loader will be used. Based on other projects this is estimated to be around 50 ltr.per day during 365 days a year per loader)
NCV_i	Net Caloric value of fuel (MJ/ltr.)	43 MJ/kg
$OXID_l$	Oxidation factor of fuel (IPCC default)	0.99
$EF_{CO2,i}$	Emission Factor of fuel (diesel) ($toCO_2e/MJ$) according IPCC	74.1 kg/GJ

The CO_2 emissions of the project activity on-site are calculated to be 115 tonnes per year. The actual fuel consumptions will be monitored for *ex post* CER calculations.

Emissions from fuel use on site:

Year	**Emissions from fuel use on site**
2008 (2 months)	49
2009	49
2010	49
2011	49
2012	49

2013	49
2014	49
2015	49
2016	49
2017	49
2018 (10 months)	49

(f) CO_2 emissions from grid electricity consumption($PE_{CO2,Elec,y}$):

In case electricity is consumed for energy requirements in the baseline, CO_2 emissions from electricity consumption shall be calculated as follows:

$$PE_{CO2,Elec,y} = EC_{project,y} * EF_{Gridelec,y}$$

where:

$EC_{project,y}$ is the project electricity consumption during the year *y* (MWh)

$EF_{Gridelec,y}$ is the grid electricity emission factor for the year *y* (tCO_2/MWh)

In cases where electricity is purchased from the grid, the emission factor EFGridelec,y should be calculated according to methodology ACM0002(“Consolidated baseline methodology for grid-connected electricity generation from renewable sources”).If electricity consumption is less than small scale threshold of 15 GHh/yr, AMS.I.D.1 may be used.

Emissions due to grid electricity consumption are considered to be zero in the project activity because all the power that is needed for the equipments will be supplied from the palm oil mill’s existing biomass boiler and steam turbine. (Note: the palm oil mill is not connected to any power electrical grid).This power source is considered carbon neutral and is not leading to any increase in emission

Total Project Emissions:

Year	**Emissions due to composting($PE_{N2O,COMP,y}$)**	**Emissions due to fossil fuel use($PE_{CO2,FF,y}$)**	**Emissions due to transportation($PE_{CO2,Trans,y}$)**	**Total Project Emissions(PE_y)**
2008 (2 months)	53	49	14.81	117
2009	317	49	85.27	451
2010	317	49	85.27	451
2011	317	49	85.27	451
2012	317	49	85.27	451
2013	317	49	85.27	451
2014	317	49	85.27	451
2015	317	49	85.27	451
2016	317	49	85.27	451
2017	317	49	85.27	451
2018 (10	264	49	71.18	385

months)				
Total	3,167	544	853	4,564

Leakage effects are not considered in accordance with the Baseline Methodology.

Table: Resulting project emissions and leakages in fixed 10 years crediting period

Year	**Total Project Emission and Leakage**
	Tonnes
2008 (2 months)	117
2009	451
2010	451
2011	451
2011	451
2013	451
2014	451
2015	451
2016	451
2017	451
2018 (10 months)	385
Total 2008-2018	4,564

Emission reductions

$ER_y = BE_y – PE_y - LE_y$

Where:

ER_y	Emission reductions during the year y (tCO_2/yr)
BE_y	Baseline emissions during the year y (tCO_2/yr)
PE_y	Project emissions during the year y (tCO_2/yr)
LE_y	Leakage emissions during the year y (tCO_2/yr)

Table: Resulting emission reductions in fixed 10 years crediting period

Year	**Total Baseline Emissions (BE_y)**	**Total project activity emissions and leakage (PE_y & LE_y)**	**Net total amount of CERs (ER_y)**
	Tonnes	**Tonnes**	**Tonnes**
2008 (2 months)	2,591	117	2,474

2009	23,223	451	22,772
2010	35,068	451	34,616
2011	45,061	451	44,609
2012	53,492	451	53,040
2013	60,604	451	60,153
2014	66,605	451	66,154
2015	71,668	451	71,216
2016	75,939	451	75,488
2017	79,543	451	79,091
2018 (10 months)	78,108	385	77,724
Total 2008-2018	591,902	4,564	587,337

B.6.4 Summary of the ex-ante estimation of emission reductions:

>>

Year	**Estimation of project activity emissions, PE_y (tonnes of CO_2e)**	**Estimation of baseline emissions, BE_y (tonnes of CO_2e)**	**Estimation of Leakage, LE_y (tonnes of CO_2e)**	**Estimation of overall emission reductions, ER_y (tonnes of CO_2e)**
Year 2008 (2 months)	117	2,591	0	2,474
Year 2009	451	23,223	0	22,772
Year 2010	451	35,068	0	34,616
Year 2011	451	45,061	0	44,609
Year 2012	451	53,492	0	53,040
Year 2013	451	60,604	0	60,153
Year 2014	451	66,605	0	66,154
Year 2015	451	71,668	0	71,216
Year 2016	451	75,939	0	75,488
Year 2017	451	79,543	0	79,091
Year 2018 (10 months)	385	78,108		77,724
Total (tonnes of CO_2e)	4,564	591,902	0	587,337

B.7 Application of the monitoring methodology and description of the monitoring plan:

B.7.1 Data and parameters monitored:

Baseline emissions:

Data / Parameter:	**ID#1 $COD_{baseline,m}$**

Data unit:	tons of COD
Description:	COD at the inlet of the project activity
Source of data:	Host facility
Measurement procedures (if any):	Calculated as the product of COD concentration in ton COD/ m^3 in the wastewater input to the project activity and the flow rate of wastewater in m^3/year.
Monitoring frequency:	Monthly
QA/QC procedures to be applied:	COD concentration is to be measured monthly using sampling techniques and flow rate is to be measured continuously. Sampling to be carried out adhering to internationally recognized procedures. Flow meters undergo maintenance/calibration subject to appropriate industry standards.
Value used in Calculations	64.646 kg COD/m^3 (from project data)
Any comment:	Samples will be tested by accredited laboratory.

Data / Parameter:	**ID#2 F**
Data unit:	Fraction
Description:	Fraction of methane in landfill gas
Source of data:	On-site measurements
Measurement procedures (if any):	
Monitoring frequency:	Annually
QA/QC procedures to be applied:	
Value used in Calculations	0.5 (default value)
Any comment:	This parameter to be used in the order of preference as below. 1. Annually measured value, 2. Measured at once before prior to the start of the project activity 3. default value of 0.5

Data / Parameter:	**ID#3 $A_{project,j,x}$**
Data unit:	tonnes
Description:	Amount of organic waste type *j* disposed in landfill in the year *x*
Source of data:	Host facility
Measurement procedures (if any)	On-site data sheets recorded monthly using weigh bridge.
Monitoring frequency:	Monthly
QA/QC procedures to be applied:	Weighbridge will be subject to periodic calibration (in accordance with stipulation of the weighbridge supplier)
Value used in Calculations	47,520
Any comment:	

Project emissions:

Data / Parameter:	ID# 4 $COD_{outlet,total,y}$
Data unit:	tons of COD
Description:	COD at the outlet of the project activity
Source of data:	Host facility
Measurement procedures (if any)	Calculated as the product of COD concentration in ton COD/ m^3 in the wastewater outlet from the project activity and the flow rate of wastewater in m^3/year
Monitoring frequency:	Monthly
QA/QC procedures to be applied:	COD is measured using sampling techniques. Sampling will be carried out adhering to internationally recognized procedures. Flow meters undergo maintenance/calibration subject to appropriate industry standards
Value used	0 (Residence time of the POME in the lagoons is >30days)
Any comment:	

Data / Parameter:	ID#5 $Dist_{i,y}$
Data unit:	Km
Description:	Distance traveled per trip during the year *y*
Source of data:	Host facility
Measurement procedures (if any)	Based on the estimation of actual distance used for transportation in the project activity.
Monitoring frequency:	Yearly
QA/QC procedures to be applied:	
Value used in Calculations	0.5 km (transporting EFB from Takon mill to composting plant) 20 km (transporting compost to plantation)
Any comment:	

Data / Parameter:	ID#6 $FC_{i,project,y}$
Data unit:	tons or m^3 (mass or volume units)
Description:	Fossil fuels of type *i* consumed by the project for energy requirements during the year *y*
Source of data:	Host facility
Measurement procedures (if any)	On-site data sheets recorded according to the monitoring frequency
Monitoring frequency:	Monthly
QA/QC procedures to be applied:	Data will be acquired based on measurement of quantity of fuel used. Measurement equipment/meters will be calibrated according to the suppliers specifications
Value used in Calculations	18,250 liters of diesel fuel
Any comment:	

Data / Parameter:	ID# 7 $FC_{i,trans,y}$

Data unit:	tons or m^3 (mass or volume units)
Description:	Fossil fuels of type j consumed by the project for transportation during the year *y*,
Source of data:	Host facility
Measurement procedures (if any)	On-site data sheets recorded according to the monitoring frequency.
Monitoring frequency:	Monthly
QA/QC procedures to be applied:	Data will be acquired based on measurement of quantity of fuel used. Measurement equipment/meters will be calibrated according to the supplier's specifications.
Value used in Calculations	32.85 litres per 100 km
Any comment:	

Data / Parameter:	**ID#8 N**$_{vehicles,i,y}$
Data unit:	Number
Description:	Number of vehicle trips used for transportation, of fuel type *i*, during the year *y*,
Source of data:	Host facility
Measurement procedures (if any)	On-site monitoring records.
Monitoring frequency:	Daily
QA/QC procedures to be applied:	
Value used in Calculations	4,840
Any comment:	Applicable for both project situation and baseline situation

Data / Parameter:	**ID#9 EC**$_{project,y}$
Data unit:	MWh
Description:	Amount of electricity consumed
Source of data:	Host facility
Measurement procedures (if any)	On-site data sheets recorded according to the monitoring frequency.
Monitoring frequency:	Continuously
QA/QC procedures to be applied:	Data will be acquired based on measurement of electricity consumed. Meters will be calibrated according to the supplier's specifications.
Value used in Calculations	0
Any comment:	No grid electricity is consumed as connection to the National Grid is not available. The electricity will be generated from mill's biomass steam plant.

Data / Parameter:	**ID#10 EC**$_{GridElec,y}$
Data unit:	tCO2e/MWH
Description:	Grid electricity emission factor during the project situation

Source of data:	Host facility
Measurement procedures (if any)	Calculated as per the most recent version of the approved consolidated methodology AMC0002.
Monitoring frequency:	Yearly
QA/QC procedures to be applied:	Data obtained from the latest local/regional statistics and calculated as per AMC0002
Value used in Calculations	0
Any comment:	No National Grid Connection available.

Data / Parameter:	**ID#11 SOD**
Data unit:	Number
Description:	Number of samples with Oxygen deficiency
Source of data:	Host facility
Measurement procedures (if any)	Samples with Oxygen content less than 10%. Measurement itself to be done by using a standardised mobile gas detection system
Monitoring frequency:	Depends on the frequency of S_{total}
QA/QC procedures to be applied:	O2 measurement instrument will be subjected to periodic calibration (in accordance with stipulation of the instrument supplier).A statistically significant sampling procedure will be setup that consists of multiple measurements throughout different stages of the composting process according to a predetermined pattern (depths and scatter).
Value used in Calculations	0
Any comment:	

Data / Parameter:	**ID#12 S_{total}**
Data unit:	Number
Description:	Total number of samples
Source of data:	Host facility
Measurement procedures (if any)	Total number of samples taken per year. Measurement itself to be done by using a standardised mobile gas detection system
Monitoring frequency:	S_{total} should be chosen in a manner that ensures estimation of S_a with 20% uncertainty at 95% confidence level
QA/QC procedures to be applied:	O_2 measurement instrument will be subjected to periodic calibration (in accordance with stipulation of the instrument supplier).A statistically significant sampling procedure will be setup that consists of multiple measurements throughout different stages of the composting process according to a predetermined pattern (depths and scatter).
Any comment:	

Data / Parameter:	**ID#13 $Q_{compost,y}$**
Data unit:	Tons
Description:	Quantity of compost produced during the year *y*
Source of data:	Host facility

Measurement procedures (if any)	On-site data sheets recorded according to the monitoring frequency
Monitoring frequency:	Monthly
QA/QC procedures to be applied:	Weighed on calibrated scale; also cross check with sales of compost
Value used in Calculations	23,760 (50% of EFB)
Any comment:	

Leakage

Monitoring of leakage is not applicable under this methodology as the co-composting technology applied will use up the entire volume of POME (50%) that is pumped and stored in the compost plant.

However, in the case of co-composting technology failure, the organic wastewater will be pumped back to the lagoons for treatment. Therefore, below parameter will be monitored:

Data / Parameter:	**ID#1 $COD_{baseline,m}$**
Data unit:	tons of COD
Description:	COD at the inlet of the project activity
Source of data:	Host facility
Measurement procedures (if any):	Calculated as the product of COD concentration in ton COD/m^3 in the wastewater input to the project activity and the flow rate of wastewater in m^3/year.
Monitoring frequency:	monthly
QA/QC procedures to be applied:	COD concentration is to be measured monthly using sampling techniques and flow rate is to be measured continuously. Sampling to be carried out adhering to internationally recognized procedures. Flow meters undergo maintenance/calibration subject to appropriate industry standards.
Value used in Calculations:	64.646 kg COD/m^3 (from project data)
Any comment:	Samples will be tested by accredited laboratory.

Data / Parameter:	**ID#4 $COD_{outlet,total,y}$**
Data unit:	tons of COD
Description:	COD at the outlet of the project activity
Source of data:	Host facility
Measurement procedures (if any):	Calculated as the product of COD concentration in ton COD/m^3 in the wastewater outlet from the project activity and the flow rate of wastewater in m^3/year.
Monitoring frequency:	Monthly
QA/QC procedures to be applied:	COD is to be measured using sampling techniques. Sampling will be carried out adhering to internationally recognized procedures. Flow meters undergo maintenance/calibration subject to appropriate industry standards.
Value used in	0 (Residence time of the POME in the lagoons is >30days)

Calculations:	
Any comment:	

B.7.2 Description of the monitoring plan:

The monitoring plan details the actions necessary to record all the variables and factors as described in the data tables of Section B.7.1. above. All data will be archived electronically, and backed up regularly. It will be kept available for the full crediting period, plus two years after the end of the crediting period or the last issuance of CERs for this project activity (whichever occurs later).
The Monitoring Plan for this project has been developed to fulfil the following key objectives:

- Provide guidance for the implementation of the necessary measurement operations
- Establish and maintain a reliable, accurate and verifiable monitoring system

Monitoring Organisation:
Prior to the start of the crediting period, the monitoring team will be organised. Clear and well defined roles and responsibilities will be assigned to all the staff directly involved in the project. A brief Organization Structure is available at Figure 5. In addition, a Project Manager will be nominated to oversee the monitoring system of this project. The Project Manager is responsible to manage the process of training

A formal set of monitoring SOPs (Standard Operating Procedures) will be established. These SOPs will detail the organisation, control and steps required for the key monitoring system features, including:

- Training of staff
- Data collection
- Data quality control and quality assurance
- Record keeping and archiving
- Equipment calibration
- Equipment maintenance
- Equipment failure

Figure 5. Organization Structure

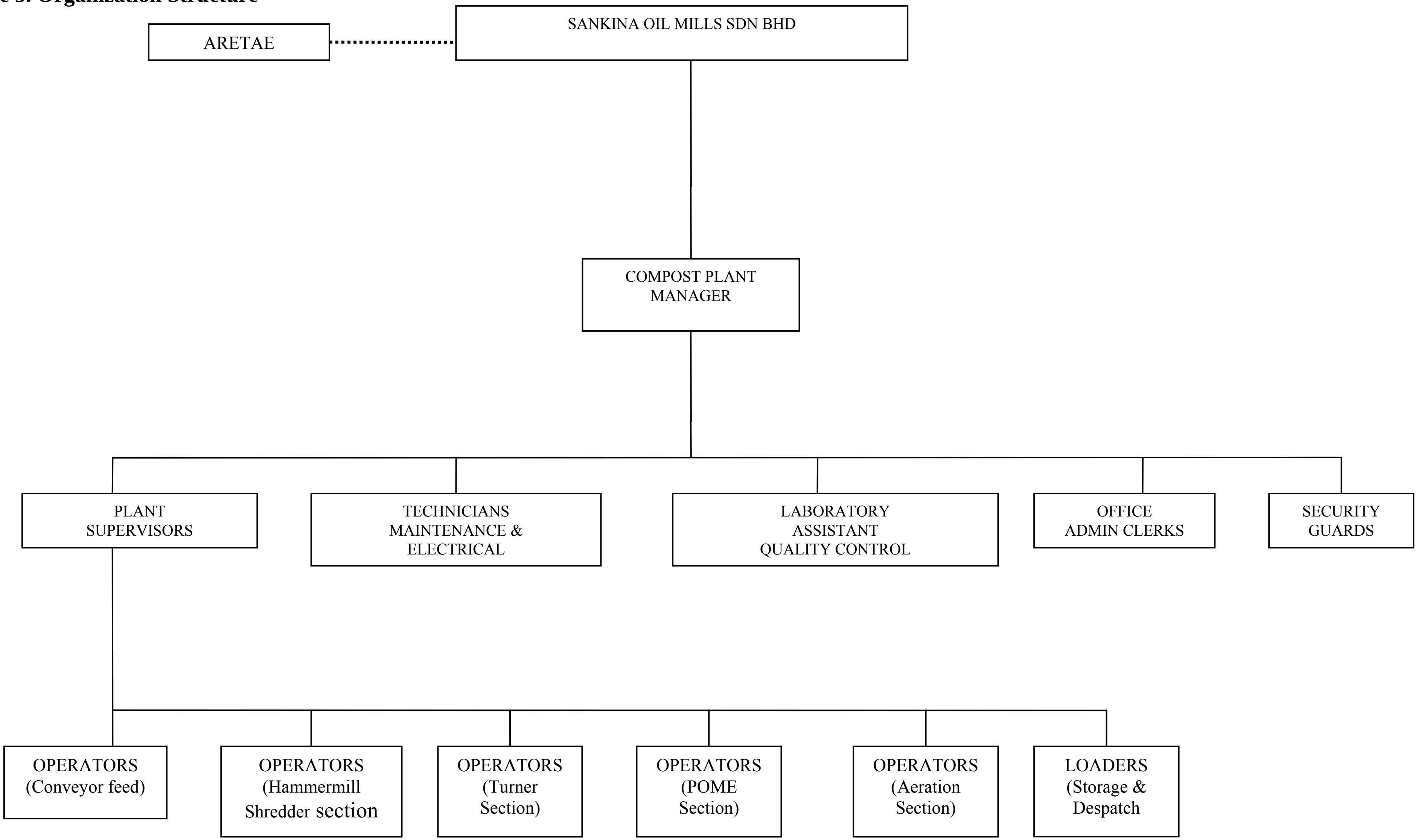


Table 4b: Equipment used to monitor emission reductions from the project activity

Equipment	Variables Monitored	Operational range	Calibration procedures	Parties responsible for operating equipment	Procedure in case of failure	Default value to use in case of failure	Comments
Weigh Scale	Weight of each substrate to plant	Tonnes	Equipment will be calibrated 18-24 months after initial installation by the equipment supplier	Project Developer	Failure reported to equipment supplier and repairs carried out. If repair is not possible, equipment will be replaced by equivalent item within one month. Failure events will be recorded in the site events log book.	Daily average of the weight in the previous month minus 5%, per day of weigh scale failure	
Portable Oxygen Gas Analyser	Mol fraction oxygen	0 to 20%	Equipment will be calibrated annually by the owner on site, calibration gases	Project Developer	Failure reported to equipment supplier and repairs carried out. If repair is	Average of the measured oxygen content in the previous month minus	

			to be supplied by equipment supplier.		not possible, equipment will be replaced by equivalent item within one month**.** Failure events will be recorded in the site events log book	5%, per day of gas analyser failure. If this brings the oxygen below 10%, the relevant PE factor applies	
Electricity meter	Total amount of electricity generated by the project and electricity consumed		Equipment will be checked monthly by the Lead Engineer	Project Developer	Failure reported to equipment supplier and repairs carried out. If repair is not possible, equipment will be replaced by equivalent item within one month. Failure events will be recorded in the site events log book.	Daily average of the electricity consumed in the previous month	

Table 4c: Operational procedures and responsibilities for monitoring and quality assurance of emission reductions from the project activity (E = responsible for executing data collection, R = responsible for overseeing and assuring quality, I = to be informed)

Task	Regional Manager	Site Engineer	Equipment Supplier	Project Developer	LFGC Ltd.
Collect Data	R	E			
Enter data into Spreadsheet	R	E		R	
Make monthly and annual reports	R	E		R	I
Archive data & reports	R	E		R	I
Calibration/Maintenance, rectify faults	I	R	E	I	I

Quality Control (QC) and Quality Assurance (QA) Procedures

All measurements will use calibrated measurement equipment that is maintained regularly and checked for its functioning. QA/QC procedures for the parameters to be monitored are illustrated in the following table.

Data	**Uncertainty Level of Data (High/Medium/Low)**	**Explain QA/QC procedures planned for these data, or why such procedures are not necessary**
1 MWh_e	Low	Electricity meter will be subject to regular (in accordance with stipulation of the meter supplier) maintenance and testing to ensure accuracy. The readings will be double checked by the electricity distribution company.
2 CEF_{elec}	Low	Calculated as per appropriate methodology at start of crediting period, IPCC default value 0.80 t/MWh used.
3 F_{cons}	Low	The amount of fuel will be derived from the paid fuel invoices (administrative obligation).
4 NCV_{fuel}	Low	IPCC 2006 Guidelines for National Greenhouse Gas Inventories Volume 2, Chapter 1, Table 1.2 IPCC default factor (43 MJ/kg) is applied.
5. EF_{fuel}	Low	IPCC 2006 Guidelines for National Greenhouse Gas Inventories Volume 2, Chapter 1, Table 1.4 IPCC default factor (74.1 kg/GJ)
6. $M_{compost,y}$	Medium	Weighed on calibrated scale; also cross check with sales of compost.
7. S_a	Medium	O_2-measurement-instrument will be subject to periodic calibration (in accordance with stipulation of instrument supplier).Measurement itself to be done by using a standardized mobile gas detection instrument. A statistically significant sampling procedure will be set up that consists of multiple measurements throughout the different stages of the composting process according to a predetermined pattern (depths and scatter) on a weekly basis.
8. S_{OD}	Medium	

9. S_{total}	Medium	
10. $EF_{c, N2O}$	Low	The value itself is highly variable, but reference data shall be used.
11. MD_{reg} or AF	Medium	Data are derived from or based upon local or national guidelines, so QA/QC-procedures for these data are not applicable.
12. A_x	Low	Weighbridge will be subject to periodic calibration (in accordance with stipulation of the weighbridge supplier).
13. P_{jx}	Low	Regular sorting & weighing of waste (initially quarterly) by project proponent will be carried out. Procedures will be checked regularly by a certified institute/ DOE.
14. F	Low	Analyser will be calibrated regularly (in accordance with stipulation of the meter supplier) by a certified institute, or the IPCC default value will be used.
15. DOC_j	Low-medium	Certified laboratory to be used.
16. DOE_f	Low-medium	AM0039 version 1 default value 0.77 to be used.
17. MCF	Low-medium	IPCC 2006 Guidelines for National Greenhouse Gas Inventories Volume 5, Chapter 3, Table 3.1 IPCC default value to be used depending on type of landfill waste goes to in absence of the Project. MCF value of 1.0 is used.
18. k	Low-medium	Measured value confirmed ex-ante.
19. $NO_{vehicles}$	Medium	Number of vehicles must match with total amount of sold compost. Procedures will be checked regularly by DOE.
20. KM_y	Low	Distance measured value confirmed ex-ante.
21. D_{fuel}	Low	Regional-specific value provided by Exxon Mobil is applied (0.85kg/L)

B.8 Date of completion of the application of the baseline study and monitoring methodology and the name of the responsible person(s)/entity(ies)

>>

Gerald P. Hamaliuk
LFGC Ltd.
200 N. Service Rd. W.
Unit 1, Ste. 410
Oakville, ON, Canada
L6M 2Y1
Tel: 1-905-334-6127
Fax: 1-905-469-4281
E-mail: jboissiere@cogeco.ca

LFGC Ltd. is the CDM advisor to the Project of this document. Aretae Pte Ltd is the CDM Consultant to the Project of this document. The baseline study and monitoring methodology were completed on June 20, 2007.

SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

>>
The time line of the project is as follows:

- Project starting date: 01/03/2007
- Construction starting date: 01/05/2008
- Construction finishing date: 01/09/2008
- Start operating of equipment: 01/10/2008

C.1.2. Expected operational lifetime of the project activity:

>>
30 years

C.2 Choice of the crediting period and related information:

C.2.1. Renewable crediting period

C.2.1.1. Starting date of the first crediting period:

>>
Not Applicable

C.2.1.2. Length of the first crediting period:

>>
Not Applicable

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>>
30/08/2008 or the registration date of the project, whichever occurs later

C.2.2.2. Length:

>>
10 years

SECTION D. Environmental impacts

>>

D.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

>>

The project involves the implementation and operation of a composting plant in Malaysia, within a Palm Oil mill complex. It does not use any scarce resources (like water); it doesn't produce any solid waste or emissions to water and soil. The (limited number of) vehicles do produce local combustion gases, and are used less than for transporting the organic wastes in the baseline. The main environmental negative component can be NOx that is an acidifying gas. The electricity used on-site is also relatively small and derived from renewable biomass.

Composting can have some local environmental impact, mainly odour emissions. Odour reduction techniques are applied. The composting plant is located remote from populated areas and utilization of the EFB will reduce the amount piled near the mill and farms and rotting presently.

Compost can improve the soil condition and will improve crop production. Compost is therefore in demand and contributes to a better environment for the agriculture run-off, as if will be greatly reduced compared to chemical fertilizer use.

The environment permit was applied for in 4 Jun 2007. The environment approval will be available during the Validation.

D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

>>

In brief, the project might have a slight negative environmental impact during the operational phase, being odour emission. However, this emission is compensated by prevented emissions from the landfills, and organic deodourizer may used to eliminate odours from the building.

No impacts during the construction phase are expected

SECTION E. Stakeholders' comments

>>

E.1. Brief description how comments by local stakeholders have been invited and compiled:

>>

The Public Forum was held at Lahad Datu Executive Hotel, Lahad Datu, Sabah, Malaysia on May 17th, 2007. An internal stakeholders meeting was held at Takon palm oil mill on 24th October 2007 to inform the internal staffs about the CDM project.

E1.1 Official reports announcing a Public Forum of the project in local newspapers:
1. May 6th, 2007, "Daily Express", "Takon Compost Plant Public Forum"
2. May 6th, 2007, "The Borneo Post", "Takon Compost Plant Public Forum"
3. May 10th, 2007, "Daily Express", " Takon Compost Plant Public Forum"
4. May 10th, 2007, "The Borneo Post", "Takon Compost Plant Public Forum"
5. May 10th, 2007, "Shihua Daily", " Public Forum for Co-Composting Project by using EFB and POME"

E1.2 There were 12 participants at the Public Forum. The attendee list is available at validation. In total, there were 17 participants at the internal stakeholders meeting.

E.2. Summary of the comments received:

>>

Public Forum,

Question 1
I am very happy to hear that Sankina Oil Mills Sdn Bhd is taking action to solve the pollution which is caused by EFB. Though the Public Forum was presented in English and Malay languages, it will be nicer to have presentation slides provided in both languages instead of English language only. This is to allow local residences who do not understand English can listen to presenter and read the slides for better understanding.

Question 2
What is the estimated investment cost of this project?

Question 3

As Sankina Oil Mills Sdn Bhd is planning to build the co-composting plant, does it also consider inviting the surrounding palm oil mills to join the project and provide relevant technology training?

Question 4
After treatment or processing of EFB into organic compost, what will be the cost savings?

Question 5
Does Sankina Oil Mills Sdn Bhd follow any environmental policy?

Question 6
How long does this CDM project last for and how is this carbon credit mechanism work?

Question 7
Who will actually fund this CDM Project?

Question 8
As the Head of the village, I feel that this environmental project will bring us many benefits. Personally, I am highly supportive and agree with this suggestion and planning. Thank you.

Internal Stakeholders Meeting

Question 1
How to process the palm waste product together?

Question 2
Our fiber can be use for the process?

Question 3
How much can be process per day the composting plant?

Question 4
What is the nutrient inside the compost after process?

Question 5
How many percent moisture in the compost material?

E.3. Report on how due account was taken of any comments received:

>>

Public Forum

For Question 1
A write-up of Project Activity in English, Malay and Chinese languages is given to every participant. In addition, the Malay version of the presentation slide is also available as a print out to any person who requires it. JCC Group will ensure that presentation slides in both English and Malay languages are available for the future Public Forums.

For Question 2

The investment cost actually depends on various factors such as the type of co-composting technology applied, the volume of the EFB & POME being processed, available infrastructure, location of plant, the labor demand and etc. Generally, it varies between USD 2 to 5 million.

For Question 3
This is a good suggestion and possibility as this project is a very good environmental protection project. However, Sankina Oil Mills Sdn Bhd should prove that the plant is working well before any invitation is made. Sankina Oil Mills Sdn Bhd always welcomes surrounding palm oil mills to work together for protecting the green environment.

For Question 4
Various types of equipment are being evaluated and the cost varies depending on processing time and quality of compost produced. All the costing will be available to the public when made available in the PDD which will be posted on the UNFCCC website upon our submission. We will select the technology based on the characteristics of EFB and its benefits to the plantation in the form of compost. Therefore, we have yet to determine the cost savings at the moment.

For Question 5
Sankina Oil Mills Sdn Bhd is a member of RSPO. It is interested and highly committed to the sustainable plantation development by giving full support to any project that addresses environmental issues.

For Question 6
This CDM project of co-composting plant will last for 7 or 10 years which has yet to be finalized at this moment.

For brief, United Nation (UN) has come out with a Kyoto Protocol Mechanism in 1997 in order to combat Global Warming by reducing GreenHouse Gas (GHG) Emission. The developed countries such as Japan, Germany and etc. are required to reduce their GHG emission amount by certain percentage annually. In order to achieve their target, they are allowed to buy the Carbon Emission Reduction (CER) or also known as Carbon Credits from CDM projects (based in developing countries) which reduce GHG emission. The amount of Carbon Credits given is depended on the amount of GHG reduced by the activities of the CDM project. The Carbon Credits that are bought by the developed countries can be used to offset the amount of GHG released. For example, if Japan releases extra 1MT of CO2, it needs to buy 1MT of Carbon Credits.

For Question 7
The CDM project will be funded by the Sankina Oil Mill Sdn Bhd.

For Question 8
Thank you.

Internal Stakeholders Meeting

For Question 1
The empty bunches and decanter will be mix together. 50% by effluent fresh will be sprayed. The process requires minimum 12% O_2 to achieve aerobic composting conditions.

For Question 2
Yes. However, the fiber will be used for the mill processing.

For Question 3

269 MT/day depend on the mill capacity (throughput) and FFB supply.

For Question 4
Nutrients of the compost include N, P, K, and Mg etc.

For Question 5
About 45% moisture present in the compost material.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Sankina Oil Mills Sdn Bhd
Street/P.O.Box:	12, Jalan Ngee Heng
Building:	Unit 30-03, Level 30, Menara Landmark
City:	Johor Bahru
State/Region:	Johor
Postfix/ZIP:	80000
Country:	West Malaysia
Telephone:	07-2231633
FAX:	07-2241546
E-Mail:	kohtt@jcc.com.my, taycl@jcc.com.my Plantation Director, Mill Controller
URL:	
Represented by:	Wong Ngan Sam
Title:	Mill Manager
Salutation:	Mr.
Last Name:	Sam
Middle Name:	Ngan
First Name:	Wong
Department:	Takon Compost Plant/ Takon Palm Oil Mill
Mobile:	019-8535249
Direct FAX:	
Direct tel:	019-8231519
Personal E-Mail:	takonmill@yahoo.com

Organization:	Aretae Limited
Street/P.O.Box:	9 Castle Street
Building:	Elizabeth House
City:	St. Helier
State/Region:	
Postfix/ZIP:	JE4 2QP
Country:	Jersey
Telephone:	
FAX:	
E-Mail:	
URL:	www.aretae.com
Represented by:	David Leong Chee Liang
Title:	Executive Chairman
Salutation:	Mr.
Last Name:	Leong
Middle Name:	Chee

First Name:	Liang
Department:	
Mobile:	+65-9818-7789
Direct FAX:	+65-6829-7070
Direct tel:	+65-9818-7789
Personal E-Mail:	david@aretae.com

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

This Project has not and will not receive public funding from Annex 1 countries of any kind.

ANNEX 3

BASELINE INFORMATION

Palm Oil Mill Operation Parameters:

Fresh fruit bunch (FFB) processing capacity		:	45 TPH
Daily operating hours		:	16 hours
Operating days		:	300 days
Estimated FFB production		:	216,000 MT/year
Production ratio	EFB/FFB	:	22% [1]
	POME/FFB	:	60% [1]
	EFB utilization rate	:	1

Waste annual production	EFB	=	47,520 MT
	POME	=	129,600 m^3

Baseline Parameters – EFB

Variable	Value	Unit
Φ	0.9	-
F	0.5	-
DOC_f	0.77	-
DOC_j	0.2	-
k_j	0.17	-
MCF	1.0	-
GWP_{CH4}	21	t CO_2e / tCH_4
$A_{j,x}$	47,520	MT/year
MD_{reg}	0.0	-

Baseline Parameters – POME

Variable	Value	Unit
$MCF_{baseline}$	0.367	-
B_o	0.21	tCH_4 /tCOD
GWP_{CH4}	21	tCO_2e / tCH_4
$COD_{,baseline}$	65	kg/m^3
f_d	4.5	m
f_t	27.7	°C
POME Volume *	64,800	m^3/year

* Only 50% of POME will be applied for the project activity.

Information of EFB Landfill

- **> 5m**
- **Mechanically compacted**
- **Managed landfill**

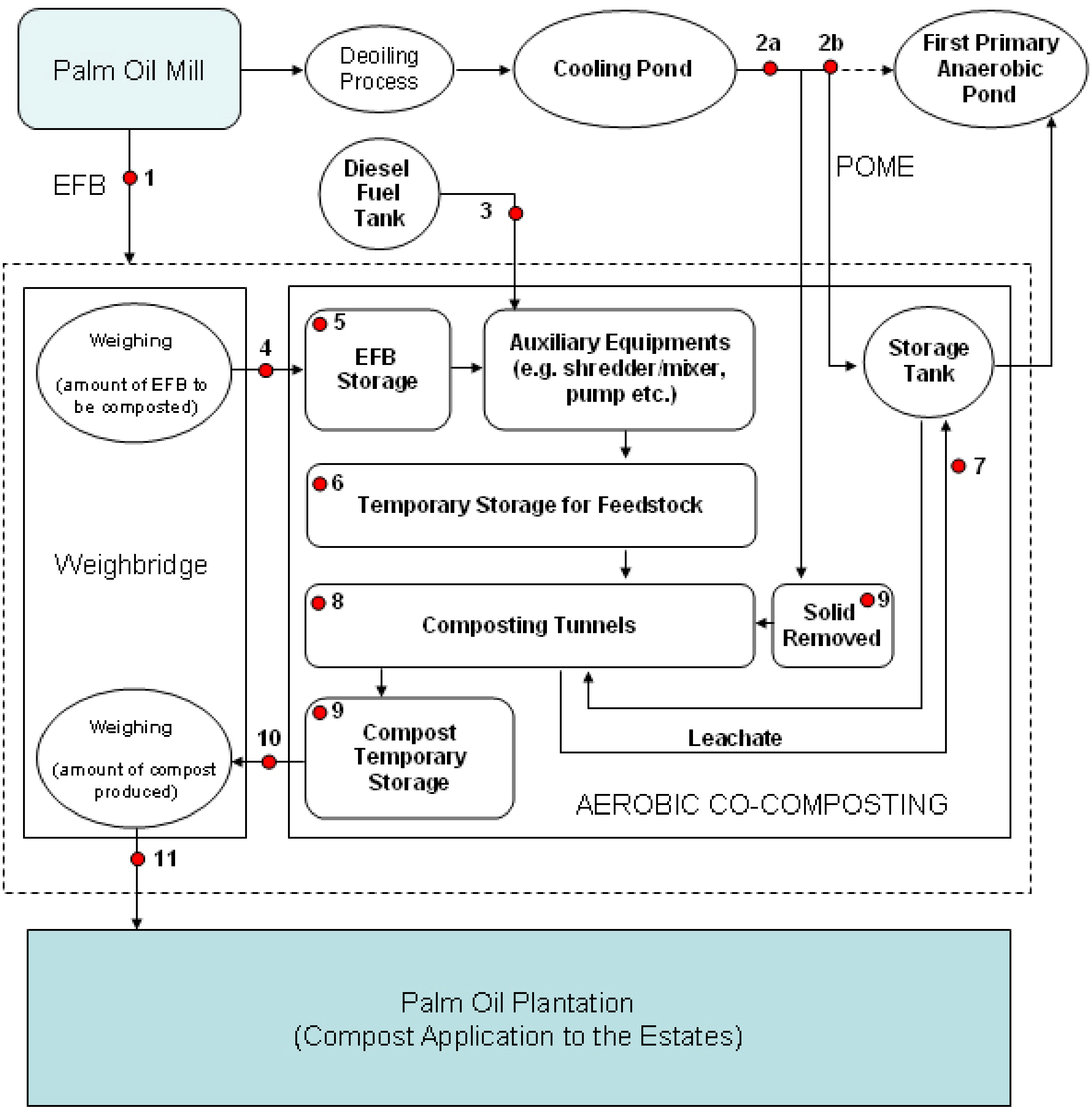
(a) EFB Landfill (> 5m)

(b) Mechanically compacted

(c) Anaerobic Pond

Annex 4

MONITORING INFORMATION



Flow diagram of monitoring points

Monitoring Points

1. Diesel consumption metering for transportation of EFB from mill to the compost plant.

   Note:
   If conveyor belt system is applied, there is no emission as it utilizes electricity from biomass steam plant in the mill.

   If new biomass steam plant is built specially for the compost plant, any start-up diesel consumption should be measure.

2. (a) Total amount of POME in the first primary anaerobic pond (by flow meter)

   (b) Total amount of POME used in the co-composting (by flow meter)

   50% of POME volume can be monitored by subtraction of (b) from (a).

   COD_{inlet} sample point (by accredited laboratory and/or own laboratory)

3. Diesel consumption metering for machineries.

4. Amount of EFB to be composted (by weighbridge or conveyor weigher)

5. Retention time of EFB storage

   Note: The emission is considered negligible since the retention time is less than 30 days.

6. Retention time of feedstock which include shredded EFB, decanter cake, and solid sludge.

   Note: Calculate methane emissions if stored more than a year

7. Measurement of excess desolided POME that sent back to the pond (by flow meter)

   COD_{leaked} sample point (by accredited laboratory and/or own laboratory)

8. Oxygen level (by metering)

   Oxygen to be monitored by portable analyzer at predetermined locations in the composting piles to give a statistically significant measure of oxygen above 10%.

   Moisture content (by laboratory testing)

   Temperature profile (by metering)

9. Retention time of the compost storage

   Note: Calculate methane emissions if stored more than a year

10. Diesel consumption metering for transportation of compost to the weighbridge if necessary.

11. Amount of compost to produced (by weighbridge or conveyor weigher)

Annex 5

INFORMATION USED FOR THE ADDITIONALITY ANALYSIS

The following pages are copied from the Financial Model used to determine the IRR, cash flows and NPV for this Project. Without the benefits from the sale of CERs, all cases for the compost project show negative or very low IRR from the cash flows. This is the reason that composting has not been carried out as a commercial business operation in Malaysia.

Project : Biomass Waste to Organic Fertilizer	
Capital Outlay required for Project:	USD 4.924 million total
Total Turnover in 5 years:	USD 27.671 million
Total EBITDA in 5 years:	USD 7.858million
IRR for Project:	13%
Payback:	6 Years
Major Assumptions :	1) CERs generated by this project at full capacity - (79,172 MT/a)
	2) Fixed Selling price of CERs @ $US 15 / MT
	3) Fertilizers sold at USD 80 / MT
	4) Ordinary Dividend declared at 50% of available profits annually

Project : Biomass Waste to Organic Fertliser

Year			**Pre-op**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Contract Year			**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
US$000	**Mth**			**2**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**10**
Annual Capacity	**23,760**	**MT of Organic Fert.**		**17%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**83%**
Annual Hours	**8720**													
CER (MT)				**2,488**	**22,853**	**34,697**	**44,690**	**53,121**	**60,234**	**66,235**	**71,297**	**75,569**	**79,172**	**77,791**
CER Sales	@ **US$15**		**0**	**37**	**343**	**520**	**670**	**797**	**904**	**994**	**1069**	**1134**	**1188**	**1167**
Sales of Fertiliser		**US$80/MT**	**0**	**53**	**1939**	**1939**	**1939**	**1939**	**1939**	**1939**	**1939**	**1939**	**1939**	**1346**
Total Revenue			**0**	**90**	**2282**	**2459**	**2609**	**2736**	**2842**	**2932**	**3008**	**3072**	**3126**	**2513**
Operating Expenses														
Biomass $4.45/MT			**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Microbes ($5,262.43 / MT)			**6**	**17**	**625**	**625**	**625**	**625**	**625**	**625**	**625**	**625**	**625**	**434**
Mechanical Shovel			**5**	**20**	**21**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**
Bagging			**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Electricity			**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Travelling			**23**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**
Staff Accomodation			**25**	**30**	**46**	**48**	**49**	**51**	**53**	**55**	**57**	**59**	**61**	**64**
Rental for land			**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Printing , Stationery & Postage			**0**	**7**	**7**	**8**	**8**	**8**	**9**	**9**	**9**	**9**	**10**	**10**
Telecomunication Charges			**8**	**18**	**18**	**19**	**20**	**21**	**21**	**22**	**23**	**24**	**25**	**25**
Insurance			**19**	**19**	**19**	**20**	**21**	**21**	**22**	**23**	**24**	**25**	**26**	**27**
Professional fees			**25**	**30**	**30**	**33**	**37**	**41**	**44**	**48**	**50**	**53**	**56**	**59**
Plant Operators wages			**37**	**75**	**78**	**80**	**83**	**86**	**89**	**93**	**96**	**100**	**103**	**107**
Plant Maintenance			**0**	**3**	**97**	**97**	**97**	**97**	**97**	**97**	**97**	**97**	**97**	**67**
Start-up Expenses			**250**	**280**	**60**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Total Operating Expenses			**398**	**548**	**1051**	**1002**	**1012**	**1024**	**1035**	**1047**	**1057**	**1069**	**1081**	**872**

EBITDA	**(398)**	**(458)**	**1231**	**1458**	**1597**	**1712**	**1807**	**1885**	**1951**	**2004**	**2046**	**1641**

Table of Assumptions

Currency Conversion Rate (US$ to RM)	3.19244	(updated until 3 March 08)
Biomass Waste (MT/a)	47,520.00	
Conversion (ratio)	0.50	
Biomass Waste Cost (per MT) in USD	0.00	
Full Capacity CER (MT/a)	79,172.00	
Full Capacity Fertilizers (MT/a)	23,760.00	
CER Price in USD	15.00	
Fertiliser Price in USD	80.00	
Annual Hours	8,720.00	
Cost of Microbes (per MT) in USD	5,262.43	
Inflation of cost (ratio)	1.04	
Inflation of Sales Price (ratio)	1.02	

The following Table shows the effect of increasing the price of fertilizer by 10%, no CER sales:

Project : Biomass Waste to Organic Fertliser

Year			Pre-op	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Contract Year			0	1	2	3	4	5	6	7	8	9	10	11
US$000	Mth			2	12	12	12	12	12	12	12	12	12	10
Annual Capacity	23,760	MT of Organic Fert.		17%	100%	100%	100%	100%	100%	100%	100%	100%	100%	83%
Annual Hours	8720													
CER (MT)				0	0	0	0	0	0	0	0	0	0	0
CER Sales	@ US$15		0	0	0	0	0	0	0	0	0	0	0	0
Sales of Fertiliser		US$88/MT	0	58	2133	2133	2133	2133	2133	2133	2133	2133	2133	1481
Total Revenue			0	58	2133	2133	2133	2133	2133	2133	2133	2133	2133	1481
Operating Expenses														
Biomass $4.45/MT			0	0	0	0	0	0	0	0	0	0	0	0
Microbes ($5,262.43 / MT)			6	17	625	625	625	625	625	625	625	625	625	434
Mechanical Shovel			5	20	21	21	22	23	24	25	26	27	28	29
Bagging			0	0	0	0	0	0	0	0	0	0	0	0
Electricity			0	0	0	0	0	0	0	0	0	0	0	0
Travelling			23	50	50	50	50	50	50	50	50	50	50	50
Staff Accomodation			25	30	46	48	49	51	53	55	57	59	61	64
Rental for land			0	0	0	0	0	0	0	0	0	0	0	0
Printing , Stationery & Postage			0	7	7	8	8	8	9	9	9	9	10	10
Telecomunication Charges			8	18	18	19	20	21	21	22	23	24	25	25
Insurance			19	19	19	20	21	21	22	23	24	25	26	27
Professional fees			25	30	30	33	37	41	44	48	50	53	56	59
Plant Operators wages			37	75	78	80	83	86	89	93	96	100	103	107
Plant Maintenance			0	3	107	221	221	221	221	221	221	221	221	154
Start-up Expenses			250	280	60	0	0	0	0	0	0	0	0	0

Total Operating Expenses	**398**	**548**	**1061**	**1126**	**1136**	**1148**	**1159**	**1171**	**1181**	**1193**	**1205**	**958**
EBITDA	**(398)**	**(490)**	**1072**	**1007**	**996**	**985**	**973**	**962**	**951**	**940**	**928**	**523**

Table of Assumptions

Currency Conversion Rate (US$ to RM)	3.19244	(updated until 3 March 08)
Biomass Waste (MT/a)	47,520.00	
Conversion (ratio)	0.50	
Biomass Waste Cost (per MT) in USD	0.00	
Full Capacity CER (MT/a)	0.00	
Full Capacity Fertilizers (MT/a)	23,760.00	
CER Price in USD	0.00	
Fertiliser Price in USD	88.00	
Annual Hours	8,720.00	
Cost of Microbes (per MT) in USD	5,262.43	
Inflation of cost (ratio)	1.04	
Inflation of Sales Price (ratio)	1.02	

Following Table shows the financial projection with the operating and maintenance costs reduced by 10%, no CER sales:

Project : Biomass Waste to Organic Fertliser

Year			**Pre-op**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Contract Year			**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
US$000	**Mth**			**2**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**10**
Annual Capacity	**23,760**	**MT of Organic Fert.**		**17%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**83%**
Annual Hours	**8720**													
CER (MT)				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
CER Sales	@ **US$15**		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Sales of Fertiliser		**US$80/MT**	**0**	**53**	**1939**	**1939**	**1939**	**1939**	**1939**	**1939**	**1939**	**1939**	**1939**	**1346**
Total Revenue			**0**	**53**	**1939**	**1939**	**1939**	**1939**	**1939**	**1939**	**1939**	**1939**	**1939**	**1346**
Operating Expenses														
Biomass $4.45/MT			**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Microbes ($5,262.43 / MT)			**6**	**17**	**625**	**625**	**625**	**625**	**625**	**625**	**625**	**625**	**625**	**434**
Mechanical Shovel			**5**	**20**	**18**	**19**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**
Bagging			**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Electricity			**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Travelling			**23**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**
Staff Accomodation			**25**	**30**	**27**	**28**	**29**	**30**	**32**	**33**	**34**	**36**	**37**	**38**
Rental for land			**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Printing , Stationery & Postage			**0**	**7**	**6**	**7**	**7**	**7**	**7**	**8**	**8**	**8**	**9**	**9**
Telecomunication Charges			**8**	**18**	**16**	**17**	**17**	**18**	**19**	**19**	**20**	**21**	**22**	**23**
Insurance			**19**	**19**	**17**	**17**	**18**	**19**	**20**	**20**	**21**	**22**	**23**	**24**
Professional fees			**25**	**30**	**30**	**33**	**37**	**41**	**44**	**48**	**50**	**53**	**56**	**59**
Plant Operators wages			**37**	**75**	**67**	**70**	**73**	**76**	**79**	**82**	**85**	**89**	**92**	**96**
Plant Maintenance			**0**	**3**	**97**	**87**	**101**	**101**	**101**	**101**	**101**	**101**	**101**	**70**

Start-up Expenses	**250**	**280**	**60**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Total Operating Expenses	**398**	**548**	**1013**	**953**	**977**	**987**	**998**	**1009**	**1018**	**1029**	**1040**	**829**
EBITDA	**(398)**	**(495)**	**926**	**986**	**962**	**952**	**941**	**930**	**921**	**910**	**899**	**517**

Table of Assumptions

		YR1	YR2	YR3	YR4
Currency Conversion Rate (US$ to RM)	3.19244		(updated until 3 March 08)		
Biomass Waste (MT/a)	47,520.00				
Conversion (ratio)	0.50				
Biomass Waste Cost (per MT) in USD	0.00				
Full Capacity CER (MT/a)	0.00				
Full Capacity Fertilizers (MT/a)	23,760.00				
CER Price in USD	0.00				
Fertiliser Price in USD	80.00				
Annual Hours	8,720.00				
Cost of Microbes (per MT) in USD	5,262.43				
Inflation of cost (ratio)		0.9	1.04	1.04	1.04
Inflation of Sales Price (ratio)	1.02				

The following Table shows the IRR, payback and NPV for the Project with CER sales.

IRR Calculator

Project Description : **Takon Compost Project**

IP #: **Biomass Waste to Organic Fertliser**

Prepared By :

Sensitivity Version # : **1** 1-Jul-08

Assumptions :

INCOME FROM OPERATIONS:	Yr 0	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Profit/ (Loss) After Tax	(398.0)	(1002.5)	504.4	771.3	794.9	915.1	984.9	1042.8	1091.3	1130.2	1161.4	862.0
SUBTOTAL TAXABLE INCOME	(398.0)	(1002.5)	504.4	771.3	794.9	915.1	984.9	1042.8	1091.3	1130.2	1161.4	862.0

ITEMS NOT AFFECTING CASH FLOW:											
Add Depreciation	352.4	352.4	352.4	352.4	352.4	352.4	352.4	352.4	352.4	352.4	352.4
Other											
SUBTOTAL	352.4	352.4	352.4	352.4	352.4	352.4	352.4	352.4	352.4	352.4	352.4

OTHER CASH FLOWS:

Capital Additions - Investment	(3523.95)											
Income Taxes		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Net Working Capital Changes	(1,400.00)											
SUBTOTAL CASH FLOWS	(4923.95)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Annual Net Cash Flow	(5321.97)	(650.1)	856.8	1123.7	1147.3	1267.5	1337.3	1395.2	1443.7	1482.6	1513.8	1214.4
Cumulative Cash Flow	(5321.97)	(5972.0)	(5115.2)	(3991.5)	(2844.2)	(1576.7)	(239.3)	1155.9	2599.6	4082.2	5596.1	6810.4

INTERNAL RATE OF RETURN, IRR	**12.93%**	12.93%
PAYBACK PERIOD	**6+**	6+
COST OF CAPITAL	**5.8%**	

RATE OF DISCOUNT	0.0%	5.0%	10.0%	15.0%	20.0%	25.0%	30.0%
NPV OF CASHFLOW	6,810	3,148	902	(507)	(1,406)	(1,985)	(2,359)
TOTAL VALUE OF PROJECT	6,810	3,148	902	-507	-1,406	-1,985	-2,359